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ONE WAY OF MAKING MONEY.

THE history of the commercial exploitation of electrical inventions includes so many incidents of an elsewhere unusual, not to say extraordinary, character that mere eccentricity in the conduct of company promoters no longer attracts attention. Whether the progress of the Standard Electric Light and Power Company has not been marked by something more than eccentricity on the part of persons prominently associated with it we shall leave our readers to judge, contenting ourselves with the presentation of incontrovertible facts. These facts have been dragged from the obscurity of the official records of Somerset House into the light of day through the acumen of a daily contemporary whose three years or more of active work in the exposure of sham and fraud entitle it to the lasting gratitude of everybody who cares at all for the preservation of commercial fair-dealing. In the *Financial News* of March 28th will be found fuller details than we shall give of what we may without exaggeration call a very remarkable achievement. A patent numbered 1,464 and dated March 27th, 1882, was granted to M. Felix de Lalande for improvements in certain electric lighting apparatus, primary batteries to wit. This patent, and some others of a similar nature, fell into the hands of Mr. J. Berger Spence (a gentleman whose name is sufficiently well known to our readers to render unnecessary any elaborate introduction) and a few of his friends. With the object of putting to practical use the important property of which they were possessed, Mr. Berger Spence and his friends in December, 1884, formed the Standard Electric Light and Power Company, Limited, with a nominal capital of £300,000 divided into 30,000 shares of £10 each. The rights for Scotland, it should be stated, had been disposed of, so that the Standard Company's operations were to be confined to England, Ireland, and Wales. Of the seven subscribers to the articles of association, three were vendors and afterwards became directors, and a fourth became the secretary of the company. By an agreement entered into between Mr. Berger Spence, on behalf of himself and friends, and the secretary of the company, the license "to use and put in practice the patents, to sell, employ and license to sell to other persons" (with a stipulation that the license "should not extend to or include the right to manufacture such piles or batteries, whether for sale or not"), was transferred to the company for the sum of £96,000, in shares of £10, which were to be considered as fully paid. A subsequent agreement gave the company the right to use certain other patents, the consideration for these being 100 fully-paid shares of £10 each. The whole of the 9,700 shares for patents were to be allotted to Mr. Berger Spence or to his nominees, but, the three directors being interested, a special resolution was passed confirming the allotment to them of about 700 of the shares. The original allotment list is not amongst the documents filed with the Registrar of Joint Stock Companies, but the first statutory return, filed on April 15th, 1885, which contains internal evidence that but little change had taken place in the interval, showed 9,707 shares issued to 22 persons. Of these 9,700 were fully-paid shares, allotted to Mr. Berger Spence and his nominees; on the remaining seven shares, £1 had been called up, and the total amount of calls received was **£6**. The list of shareholders made up to November 12th, 1886, bore witness that considerable activity had been displayed by the holders of the 9,700 fully-paid shares in ridding themselves of as many as possible of those shares, for the shareholders now numbered 62, whilst the summary in no way differed from that of April, 1885: there were still 9,707 shares taken up, 9,700 being considered as fully paid up, and six having £1 paid; so that there had been simply a shifting of fully-paid vendors' shares from one person to another, without any additional contribution to the funds of the company.

That bourne from which very few joint stock companies ever return, liquidation, has absorbed the Standard Electric Light and Power Company, and we are not aware that it possesses any inherent merits likely to secure its survival. Of the Lalande-Chaperon battery we gave our opinion last year, namely, that its advantages were much exaggerated, and that it was no advance upon what had already been accomplished in the same direction; that it was, in fact, inferior to what was already on the market. We have had no reason to change that opinion. The company can point to no installation of importance which it has erected or supplied; indeed, it is doubtful whether it has ever transacted any actual business. Many of the present shareholders, we should imagine, must have paid some amount or other for the shares standing in their names; but by what means they were induced to do so remains a secret. It is in the power of the liquidator to effect a searching scrutiny into the *modus operandi* of the promoters, and we hope that scrutiny will take place.

Electric Lighting of a Newspaper Office. — The *Freeman's Journal*, the leading newspaper in Ireland, has just had its offices and part of the compositors' room fitted with a small trial installation of electric light, consisting of 22 incandescent lamps and one small arc of 400 candle-power. The wiring throughout the front offices is run in white to match the colour of the walls, and the fixtures consist of pendants with ornamental brass mountings and opal globes; the lamp holders are of the new MacCarthy pattern, for which the inventor claims that they hold the lamps perfectly rigid without the use of Paris plaster or other filling, and that they are perfectly damp and dust tight. We understand that the light if found satisfactory at the end of two months will be extended throughout the entire building. The installation was erected by Mr. C. C. MacCarthy, of Dundalk.

THE ELECTRIC LIGHTING OF TRAINS.

MESSRS. R. E. CROMPTON and J. Swinburne have recently patented some improvements in the electric lighting of trains, which appear likely to be of considerable value. One of the difficulties in train lighting is that if the dynamo is driven from the axle it does not go at a uniform speed. To get over this difficulty, the inventors adopt the following arrangement :— The dynamo is driven off a countershaft, which is driven off the axle of a carriage or van. The countershaft is in the same horizontal plane as the axle, so that the movement of the carriage relatively to the wheels does not affect the dynamo. The dynamo is in connection with secondary cells. The field magnets are wound with two wires : one is in shunt to the armature as if the dynamo were an ordinary shunt machine wound to work at a low speed, say, 500 revolutions. The lamps are in shunt to the armature also ; but the cells are so connected up with the second wire that if the dynamo charges them the current goes round the field magnets by the second wire, so as to demagnetise them. Thus the dynamo is like a compound machine wound to work with a low speed, and having more main than usual, and that main coupled up backwards, the lamps being in shunt to the armature only, and the cells in series with the backward-wound main. The result is that as the speed increases above 500 the dynamo charges the cells, but the pressure on the lamps does not rise much, as the field is demagnetised by the current going to the cells. The second wire is so arranged that at the maximum speed the cells take their maximum charging current, which demagnetises the fields to the right degree. If the speed falls below 500, the cells begin to help the dynamo by supplying part of the current to the lamps, and in so doing they magnetise the field more strongly, so that the dynamo does not stop giving current till it goes at, say, 300. The second wire or backward main is made thick, so that there is little loss of pressure even with a large current to the cells.

As the train sometimes stops and sometimes goes backwards, means must be taken to prevent the current from the cells from burning the armature up when stopped. The inventors state that the method they find to answer well in practice is to have a cut-out in circuit to break the armature connections when the speed falls below a certain value. The dynamo is driven in the usual way, so that when the train stops or reverses the dynamo does so too. In this case the brushes must be shifted on reversal. To effect this the brush carrier or cross bar is mounted on the axle so as to turn with it, but is held by adjustable stops, so that if the machine goes one way the brushes go round until the stop holds them in the right position for that direction of rotation, and if the train goes the other way the brushes are carried about half a revolution until they come to the other stop. Tangent brushes, or brushes that will allow the commutator to run either way under them, are used.

A centrifugal or other suitable governor works a cut-out which cuts out the armature when the speed is too low, and puts it in again when high enough. This governor may also cause the short-circuiting of the backward main when the armature circuit is broken. It may be mounted on the dynamo shaft.

Instead of a speed cut-out, an electric arrangement may be used which is actuated by the armature electromotive force in making circuit, and by the discharge of the cells in breaking it. There are many ways of doing this by double-wound electro-magnets ; and the field magnets may be made to polarise the cut-out.

Electric Lighting of Steamers.—A new steamer—the *St. Sunniva*—has just been launched at Aberdeen for the Norwegian tourist traffic. She is fitted up in a luxurious fashion, and will be lighted up with electric light throughout.

RICHARDSON'S ARC LAMP.

THIS lamp, the invention of Mr. A. W. Richardson, of Manchester, is shown by figs. 1, 2, 3 and 4 ; fig. 1 being a front elevation, fig. 2 a side elevation, fig. 3 a sectional plan on line, *x*, fig. 1, and fig. 4 a sectional elevation of the regulator and clutch.

In these figures, A is the framework of the lamp. B the negative carbon, carried in a socket, *b*, in the base of the frame, A. C is the positive carbon, carried in a socket, *c*, at the end of the carbon holder, D. The holder, D, passes up through a hole in the plate, E. On the plate, E, two electro-magnets, F and G, are fixed, one, F, is wound by coils of the main circuit wire passing round its core, *f*, and the other, G, is wound by a much greater number of coils of a fine wire, offering considerably more resistance to the electric current than does the main wire. The wire of the magnet, G, forms a shunt circuit, through which the current passes when the resistance in the lamp is great compared

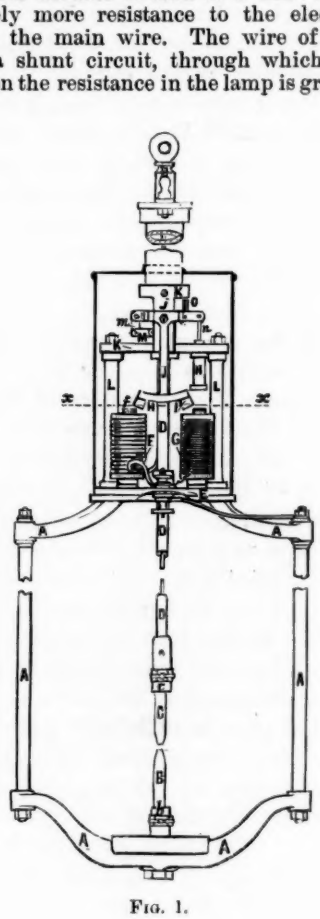


FIG. 1.

with the resistance through the shunt circuit. When the whole current passes through the shunt circuit, the magnet, G, is formed into a much more powerful magnet than is the magnet, F, owing to the greater number of coils with which it is wound. The armatures, H and I, of these two magnets are carried by a pivoted or swinging lever, J, pivoted at *j* to a socket, K, carried by the standards, L. Through the centre of the socket, K, the carbon holder, D, passes, and is acted upon at one side by a clutch, M, which is pivoted to a lever, *m*, linked to the cross head of the lever, J. N is a cylinder filled with liquid, in which works a piston connected by the rod, *n*, to the other end of the cross head of the lever, J, forming a buffer to prevent too much oscillation of the parts. O is an adjustable screw to regulate the distance that the lever, J, may be drawn over towards the shunt magnet, G. In fig. 4 the armatures and levers, J, are shown in position when attracted by the magnet, F, in the main circuit, and the dotted lines show the position when attracted by the magnet, G, in the shunt circuit. When the armatures hang in a central position between the two magnets, the clutch, M, is fitted so as to grip the carbon holder,

D, and prevent any movement. On the armature being attracted towards the magnet, F, in the main circuit, the clutch tightens on the carbon holder, and slightly raises it, but when the armature is attracted in the opposite direction towards the magnet, G, in the shunt circuit, the carbon holder is released and allowed to descend by its own weight.

In operation the invention works very simply. In the first instance, the two carbon points are placed in contact before the current is turned on. The current passing through the coils of the magnet, F, attracts its armature, H, thereby raising the carbon holder, D, by means of the clutch and thus striking the arc. As the carbons consume, the resistance in the lamp increases by reason of the greater length of the arc, until the resistance is greater than that of the shunt circuit round the magnet G. The current then passing through this circuit magnetises the magnet, G, until it is more powerful than F, attracting the armature over and releasing the clutch, which allows the carbon to descend. The resistance in the lamp is thus reduced, and less of the current passes through the shunt

FIG. 4.

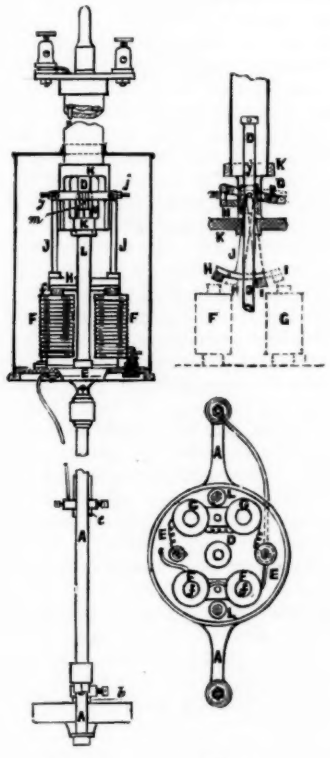


FIG. 2. FIG. 3.

circuit, so that the magnet, F, again attracts the armature, and holds it until it is again attracted by the magnet, G. When the lamp is extinguished the carbon holder is released by the clutch, and the two points come together, and are again ignited as before. The lamp can be constructed with rack carbon holders and clockwork with brake wheel and fly or escapement, on the verge or pallet principle. When the main magnet attracts the swinging armature, it lifts the clockwork and rack, together with the upper carbon, which strikes the arc; at the same time the brake wheel is brought in contact with the brake. As the arc increases, the shunt magnet attracts the swinging armature, which causes the clockwork with the upper carbon to be lowered. When the clockwork approaches the bottom of its range, it releases the brake wheel from the brake, which is then free to rotate or reciprocate, as the case may be. This closes the arc to its normal size, which causes the main magnet to strengthen and the shunt magnet to weaken. The main magnet will thus attract its armature, and its movement will raise the clockwork and bring the brake wheel in contact with the brake, and thus check further descent of the carbon until the intensity of the magnets change again.

An important feature claimed for the lamp is that it is wholly self-regulating or adjusting, or if not, to a greater extent than is at present the case with any other electric arc lamp, so much so, as to regulate the light according to the speed of the dynamo or the force or intensity of the current; that is to say, if the speed of the dynamo be decreased, which will cause the current and electromotive force to lower, the lamp will give a light equivalent to the current supplied, and *vice versâ*, if the speed of the dynamo be increased, the light will increase also.

THE IMMISCH MOTOR.

WHEN, in November last, we gave some details of the construction of the motor patented and manufactured by Mr. Immisch we promised to return at another time to the subject of their applicability to tramway purposes, a field in which we are convinced there will be within a very short time an immense development. We were pleased to hear, on paying a second visit to the works recently started at Kentish Town, that, even during the few months they have been in operation, there has been a steady increase in enquiries for motors for a variety of purposes, and also that with respect to certain types the demand is even in excess of the present resources of the establishment. In fact, it has been found necessary to increase the machinery to a considerable extent, the whole of which it is proposed to drive with a 40 horse-power motor now in process of construction.

Experiments have for some time been conducted here in relation to tramway requirements, such as improved reducing gear, simpler reversing arrangements, the increase of the efficiency of the motor, the reduction of its weight and dimensions, and its more perfect regulation. With respect to gearing, two systems have been tested in various ways, each appearing to possess certain advantages of its own calculated to lead to its preference over others in special circumstances. In one case the motor spindle is terminated at each end by a phosphor bronze pinion, which gears into a spur wheel of the same metal attached to the driving wheel with teeth on its inner side, the pinion having ten teeth and the wheel sixty-seven. The other system is that of a four-threaded worm on the motor shaft working into a corresponding wheel on the driving axle, similar to the arrangement illustrated on page 570 of the 19th volume of the REVIEW.

Mr. Reckenzaun has advocated the latter kind of gearing for this particular purpose, contending that, with clean and well fitting bearing surfaces, together with multiple threads so as to render the angle of the teeth proportionately large, it will furnish a durable, efficient, reliable and silent mode of transmission such as is required for tramway propulsion. On the contrary, he considers toothed-wheel gearing out of the question on account of the noise and vibration inseparable from it.

As far as one could judge under the circumstances, the examples at Mr. Immisch's works appear to bear out these contentions, and the fact that Mr. Holroyd Smith has lately adopted the worm and wheel gearing would tend to indicate that practical experience has led him also to give it a preference over others.

Mr. Immisch has recently contrived a new reversing gear in connection with his motors for tramway work, possessing novel points, and calculated to reduce the operation to the utmost possible simplicity.

With reference to the relation of efficiency to weight, it is claimed for these motors that they are unsurpassed. A motor developing 10 horse-power at 1,000 revolutions weighs 6½ cwt., about 70 lbs. per horse-power.

Very accurate regulation has been obtained by following the latest methods in construction, as will be seen from the following figures taken in an experiment with a dynamo and motor about to be packed for Australia, to be used in the transmission of power from a water fall to a gold mine at a distance of a mile and a-half. The motor was shown driving a second dynamo, and the load was varied by shunting the field of this machine and varying the resistance of the shunt. The generating dynamo is of the single magnet type, placed horizontally, and at 900 revolutions is calculated to give 25 horse-power, its weight being 17½ cwt. The dynamo running at 580 revolutions, the motor gave the following results :—

780	revolutions,	193	volts,	20	ampères
750	„	89	„	7	„
800	„	258	„	31·2	„

A novelty in the way of small power for driving lathes, domestic machinery and similar purposes, is a half horse-power motor, capable of working up to one horse, the dimensions of which are, length 9½ inches, width 10 inches, height 6½ inches. An interesting illustration of the electrical transmission of power is afforded in the factory adjoining that of Mr. Immisch, where an 8 horse-power motor is used in connection with a very large printing machine, such as is employed for producing at one impression the pictures in several tints which generally form part of the extra numbers of the illustrated papers. This has now been in operation for some months, without a hitch and without involving the least trouble to those employing it.

THE EXPERIMENTS OF MR. RUDOLF EICKEMEYER ON THE MAGNETIC CIRCUIT.

IN a recent number of the *Electrical Review* of New York is fully reported a paper read by Mr. Rudolf Eickemeyer at the Electric Club meeting of the 3rd ult., and entitled "Some Remarks on the Magnetic Circuit in its relation to a New Type of Dynamo Electric Machine."

Mr. Eickemeyer's paper is of a practical character inasmuch as it records results of actual experiments made by the writer, but criticism is partially disarmed by the confession that it is wholly the work of an amateur, who is not familiar with electrical phrases. That the experiments lack completeness is abundantly manifest in the paper; generally they are of that vague and unsatisfactory kind which, though covering a deal of ground, teach very little. Examine a few of them. Describing first the poleless field produced in a closed ring of soft iron Mr. Eickemeyer maps out the field produced by a ring cut open at one place, with the two ends forming the poles a little bit removed, and proceeds to show that we have in this opening a field of force available for the rotation of an armature; or we can have as many fields of force and as many armatures as we make cuts in the iron ring. Mr. Eickemeyer's object is to determine the value of each of two such fields when the ring is cut in two places as compared with the value of the original field when the ring was cut in one place, and to make the determination he constructs a machine as follows. Two semi-circular electro-magnets are supported on a frame, so as to leave between them two equal openings diametrically opposite to each other. In one opening a copper disc is rotated, while the other opening can be plugged up with a close-fitting soft iron piece, somewhat greater in diameter than the electro-magnets. When the copper disc was rotated, the deflections obtained on a tangent galvanometer were—with the iron plug in, 19°; with the plug out, 14°; or, roughly, the electromotive force was one-half more with the plug in than with the plug out. The next experiment consisted in substituting for the rotating copper disc an iron one of the same thickness, when the following results were obtained—with the plug in the deflection was 33°, with a plug of thickness equal to that of the rotating disc, substituted for the close fitting plug, 24°, with the plug removed, 19°.

Now these experiments, although qualitatively demonstrating the fact—already known—that iron is a better conductor of magnetism than copper or air are valueless from a quantitative point of view. We have no dimensions given of the magnets employed, nor have we any record of the excitement supplied. We are left to guess the dimensions of the air spaces, and the thicknesses of the iron disc and plugs are unknown. Nor do the values above given represent in their true light experimental results, since they lead to an inference which if not false is incomplete. For one value of the exciting current, and for one only, do the comparative values above stated hold good. Were the magnetic excitement increased the difference between these results would be lessened, while decreasing the exciting current would produce in them a greater difference.

The magnetic conductivity of a piece of iron depends upon the degree to which it is already permeated by lines of force. If the lines of force are densely crowded into it, its conductivity is small; if, on the other hand, the lines of force are few, the resistance of the iron part in a magnetic circuit like that of Mr. Eickemeyer might almost be neglected as compared with the resistance of the air spaces. In the first experiment the resistance of the air space is practically doubled by withdrawing the iron plug, but the lines of force are reduced by only 30 per cent. The conclusion is that in the iron they were pretty densely packed, the resistance of the iron part being in consequence comparable with that of the air space.

In the discussion Mr. Eickemeyer seems to grasp the idea that the relative values obtainable will be different for different degrees of excitation. He says, "the closer the circuit the less will the machine be affected by ampère turns. . . . . If you build a machine with an open circuit, that is a machine that has facility to pass its magnetic current into space, it will answer to an increase of the exciting current pretty much indefinitely. While in the other case when you enclose it in a shell making a closed circuit of it you reach its maximum much earlier." This translated into exact language means that of two machines, one with the magnetic circuit nearly completed in iron, and the other with intervening air spaces of considerable thickness, the first will have a magnetisation curve which as the ampère turns increase rises very rapidly, bends over and becomes nearly flat, while the other will rise steadily from its origin in a line of slight curvature. Whether these two curves will eventually coincide depends upon several conditions which need not here occupy our attention, but the main fact to be observed is that until we have complete data giving the magnetisation curve for each condition of the magnetic circuit, we cannot ascribe to the experiments scientific value.

It is feared that a criticism similar to the above must be made regarding the experiments of M. Marcel Deprez on the intensity of the magnetic field. These experiments, which were reported in the ELECTRICAL REVIEW for November 5th, 1886, led M. Deprez to conclude that in a dynamo the intensity of the field decreases much less rapidly than the distance of the poles increases. He found that the strength of the field still preserved half its primitive value when the space between the adjacent poles of two electro-magnets had been increased ten-fold, an experiment which is in no way conclusive, however, since in this case as in that of Mr. Eickemeyer, the comparative values depend upon the degree to which the magnets are saturated and are different for all values of the ampère turns. M. Deprez's conclusion is correct; that the intensity of the field decreases less rapidly than the distance of the poles increases is undoubtedly true, but

to express the whole truth the further statement is required that the proportion in which they vary depends on the excitement supplied.

Mr. Eickemeyer goes on to show that the resistance of the magnetic circuit can be reduced by extending the polar surfaces, and describes several rudimentary machines in which this had been done. He next describes the results produced by a different disposition of the magnet coils, and leads up to his experimental dynamo which may be described as having a Gramme armature in a set of Siemens curved magnets. The magnetising coils however are wound directly over the armature and quite encased by the wrought iron bars, the machine being thus converted into one of the so-called ironclad type. The object in all dynamos is, of course, to magnetise the armatures, and were there nothing to consider but how this could best be done decision would be easily arrived at. But there is more. It will be found that the ironclad dynamos having their armatures surrounded by coils and iron are the most awkward to repair or to take to pieces. No matter how well machines may be made, irrespective of the care bestowed in their construction they are still machines, and in machinery of every kind the designer keeps in view as one of the principal objects to be attained in his design facility for repairs. It may be that in constructing machines in which an armature can be rapidly exchanged, we are preparing for the day that shall never come. So much the better if the day does not come, but so much the better again if when it comes the delay is but trifling. Given two machines similar as regards output and efficiency, and the one which can be more rapidly taken to pieces and put together again is the better of the two. It is doubtful if ironclad dynamos of similar output can be made lighter than machines of the single magnet type, but whether or not the only advantage which can be achieved over and above results already obtained is a slightly diminished weight of copper for a given output. In Mr. Eickemeyer's new dynamo, judging from the drawing, the armature cannot be removed without dislodging the magnetising coils, and to do this the machine must be taken to pieces. Having no particulars of the machine we cannot criticise its performance, but in our opinion the magnetising of the armature by the indirect method of placing coils on magnet bars is preferable to any method yet devised of directly winding the coils over it. W. B. E.

SPARKING IN TELEGRAPH RELAYS.

IN most of the rapid telegraph translators now in use the signals are repeated by the tongue of a relay playing between two stops, which are connected to the opposite electrodes of a battery: the middle of the battery being connected to earth. In these translators the short-circuiting of the battery is of common occurrence, and may occur either from the formation of an arc between the contacts, or from a piece of metallic dust bridging over the play between the contacts. The formation of an arc occurs only when batteries of too low an internal resistance are used. When the batteries have too low a resistance per cell, the resistance may be artificially increased by adding resistance coils, as is done on the quadruplex.

The law which governs the resistance per cell required to prevent the formation of an arc is given by the formula

$$\frac{n\,\mathrm{E} - 40}{n\,c} = r;$$

where E is the E.M.F. per cell, r the resistance per cell, and n the number of cells in the whole battery. The value of c, which gives the best results upon fast translators, is about $\frac{1}{3}$; but fairly good results are obtained with a value of c at $\frac{1}{2}$.

Each time the tongue of the relay breaks the circuit when moving from the one stop to the other a spark is produced. These sparks result from three different causes. Thus, when the battery's resistance is too low, the battery in attempting to form an arc produces a spark; the electro-magnetic inertia of the circuit produces a spark, as also does the presence of a piece of metallic dust, by prolonging the contact of the tongue with either of the stops. There is a marked difference in the colour of the sparks produced by these three different causes. Those caused by a battery of too low an internal resistance are white; those caused by the electro-magnetic discharge are violet; while the sparks due to the presence of metallic dust between the contacts are red in colour. Each of these different kinds of sparks may be reduced to a minimum by suitable means. The best remedy for the first kind is to keep the resistance of the battery sufficiently high. The electro-magnetic discharge may be diverted from the contact points by increasing the electro-static capacity of the line, and by removing the galvanometer coils or other apparatus from the path of the outgoing current. Upon circuits which contain cables or much underground work, the electro-static capacity of the circuit tends to divert the electro-magnetic discharge from the contact points. Thus the capacity of the cables across the Irish sea effectually cut off the discharge of the instruments in Ireland from the contact points of the translating apparatus in England. When much condenser capacity is added to a line to suppress the electro-magnetic discharge, it is necessary to put a retardation resistance in the path of the condenser, otherwise the sudden rush of electricity into the condenser will fuse together the contacts.

Each time the contact between the tongue and contact stop is broken, by the tongue moving from the one stop to the other, a slight fusion of the contact takes place; and if the batteries are of sufficiently low a resistance to permit of the formation of an arc, the contacts also get oxidised. But with properly kept batteries having a sufficiently high resistance, there is no perceptible oxidisation of the contacts. The slight fusion of the metal that takes place each time the contact is broken roughens the surface of the contact points: the metal being drawn out into a number of fine points, around the base of which points there is a corresponding small hollow. The appearance of the contact points under a microscope is not unlike a map of the moon. The growth of this roughness of the contact points reduces the free play of the tongue, and ultimately the sending battery becomes short circuited and it then becomes necessary to open the plug. Sometimes the working of the tongue knocks off some of the pieces of roughened metal, which, still clinging to the roughened surface of the contact points, will bridge over the play, forming an incandescent filament as it were, say of about 1Ω resistance.

Once, twice, or three times a day (according to the amount of work the relay performs) it becomes necessary to rub off the roughness from the contact points. This is done by a burnisher, which is kept clean and slightly rough by rubbing it upon fine emery paper. After the points have been burnished, the metallic dust left upon the points by the burnisher should be wiped off by a piece of leather.

The necessity for continually cleaning the contacts of translating apparatus is caused by the very much smaller play required with this than with other kinds of telegraph instruments. The play of a translating relay upon a long line would be $\frac{1}{1000}$ to $\frac{1}{3000}$ of an inch for Wheatstone working, and, say, $\frac{1}{500}$ inch for key speed. The play used upon a neutral spring relay ranges from $\frac{1}{200}$ to $\frac{1}{800}$ inch each side of the tongue. W. MOON.

The Guernsey and Alderney Cable.—In answer to Mr. Bartley in the House of Commons, Mr. Raikes stated that the telegraph cable between Guernsey and Alderney was broken in December, and would, it was hoped, be repaired early in May. The delay in restoring communication was due to the danger of employing a cable repairing ship in such a sea during the stormy weather of the winter.

ELECTRICAL DISTRIBUTION BY ALTERNATING CURRENTS AND TRANSFORMERS.

By RANKIN KENNEDY.

(*Continued from page* 281.)

TRANSFORMERS.

A SYSTEM employing continuous currents in the main conductors at constant E.M.F. has often been proposed, notably by T. A. Edison in 1883. In this system the primary currents in the transformers are rendered alternating by a rotating commutator. Enquiries have been made during the last year in every likely quarter, and numerous experiments have been made, but no information can be obtained as to how we are to construct the very pith and marrow of this system, namely, the commutator, which is to reverse currents

FIG. 4.—FARADAY, 1835.

of 5 or 10 ampères at the rate of 120 reversals per second with a pressure of 1,500 or 2,000 volts. This patent is no doubt of great value as a patent, but somebody has yet to invent that commutator, and after that the inventor of it would be called up as an infringer if he put it into practice.

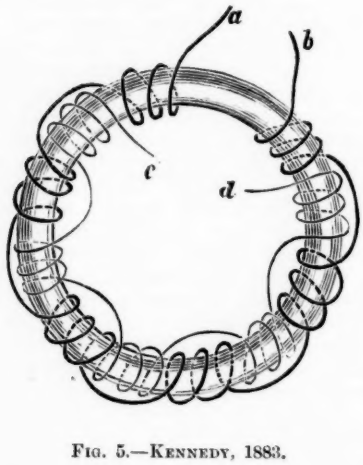


FIG. 5.—KENNEDY, 1883.

A far better system of generating alternating currents from a continuous current was invented by Mr. Henley many years ago; the instrument is described in Noad's Electricity by W. H. Preece, page 358. If the commutator difficulty were overcome this machine, with a slight modification, would work well in a continuous current system.

We shall now see what has been the history of the transformers themselves; they have been developed by a true process of evolution from the original transformer of Faraday shown at fig. 4. In this transformer we have all the elements of the best type of transformer; first, an iron core, which forms a magnetic circuit completely closed or formed of iron throughout; second, a primary conductor, A. B; third, a secondary, C, D.

In 1842 Ruhmkorff's coil, fig. 9, was invented; in this transformer we have an iron core forming a straight bar, and the magnetic circuit is completed through the air; we have also the two conductors, A, B, and C, D. This form has received great attention during the last 40 years, and was employed by the earlier inventors in distribution systems up to 1883, notably by Jablochkoff and Gaulard and Gibbs. Like the series system with which it was connected, it has now been abandoned in favour of the transformer invented before it by Faraday, namely, the transformer with a magnetic circuit entirely of iron.

In transformers as in dynamos, it has been found necessary to reduce the resistance of the magnetic circuit to the smallest possible value; this is done in three ways—making the circuit entirely of iron, reducing the circuit in length as much as possible, and increasing its cross section.

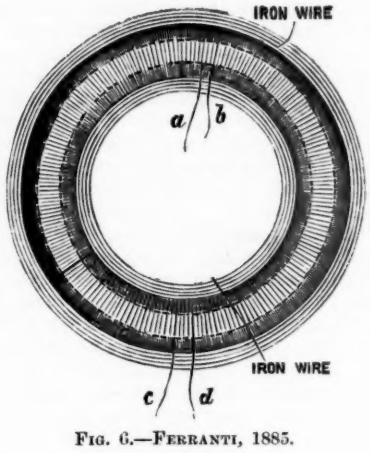


FIG. 6.—FERRANTI, 1885.

In 1883 I employed a Gramme ring as a transformer, fig. 5, and found the advantages of the closed magnetic circuit very great. This transformer is practically the same as Faraday's with the improvements in the core; in Faraday's transformer it is of solid iron, in mine the core is of fine iron wire.

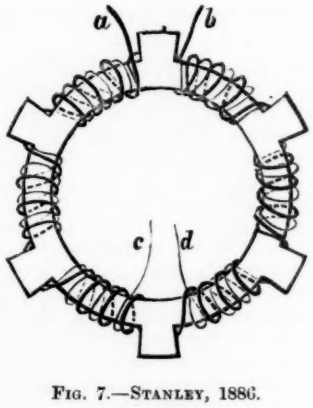


FIG. 7.—STANLEY, 1886.

Following me in 1885 Zipernowski and Déri patented the ring which I had used in 1883; lately, however, they have disclaimed this patent.

Ferranti improved the ring, fig. 6, by winding an iron wire or strip on the peripheries, thereby somewhat reducing the magnetic resistance.

Stanley made a transformer of the Paccinotti ring, fig. 7, but it is no improvement, as may be readily seen;

the projecting teeth have some reason for existence in an armature for a dynamo, but I can see no reason for them here and none is given by the inventor.

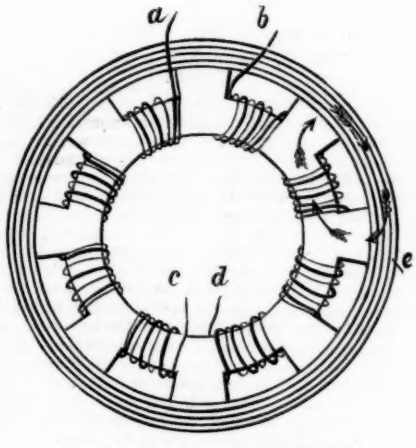


FIG. 8.—DICK AND KENNEDY, 1886.

Dick and Kennedy make a transformer of a Paccinotti ring, fig. 8, and give the teeth a very important function to perform, by winding a sheathing of iron

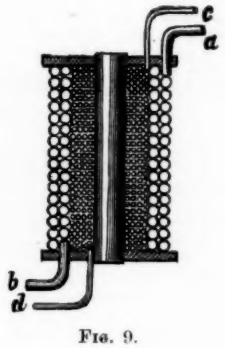


FIG. 9.

wire on the outer periphery. The teeth with this magnetic sheath form short magnetic circuits for each pair of coils as shown at C.

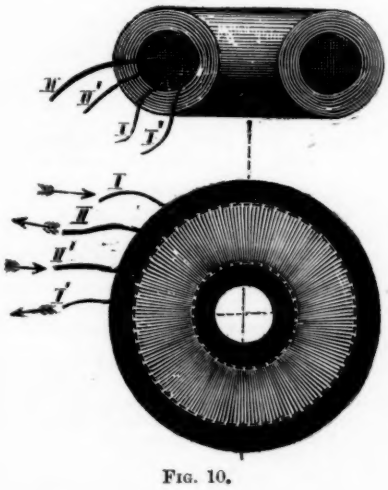


FIG. 10.

This evolution is very interesting and forcibly illustrates how far important practical results depends on apparently trifling improvements; thus we have Faraday with a solid iron cored ring, then follows the ring with fine iron wire core, then with an outer and inner iron sheath, then with teeth without a sheath, then with teeth with a sheath added and wound in magnetic contact with them.

The addition of the sheathing in the Ferranti ring reduces the magnetic resistance in the ratio of about 2 to 1; the sheathing in the Dick and Kennedy ring reduces the magnetic resistance in the ratio of about 6 to 1, and this reduction could be carried further. These are all the developments of the simple ring form; the improvements are altogether in the magnetic organ of the transformer.

In the 1885 patent of Zipernowski and Deri, we have the most novel development of the ring, producing the highest class of transformer and reducing the magnetic resistance to a very small value; this invention consists in forming the two conductors into a core of ring form, and then overwinding them with iron wire; in fact, it is the transformer of Faraday's turned inside out, instead of the conductors enclosing the iron the iron encloses the conductors.

Fig. 10 shows this construction, the ends of the conductors, I, I′ and II, II′, coming out through the sheath of iron wire.

The sheathed forms of transformers have one practical objection, and that is, when a fault occurs in the insulation or in the conductors, the whole of the winding has to be undone to make a repair; this has been overcome in later transformers.

(*To be continued.*)

ON THE APPLICATION OF ALTERNATING CURRENTS TO THE DETERMINATION OF THE CONDUCTIVITY OF ELECTROLYTES.*

By T. C. FITZPATRICK, Scholar of Christ's College, Cambridge.
(Communicated by W. N. SHAW.)

THE work described in this paper was undertaken with the view of testing the method of the alternate current as applied to the measurement of the resistance and conductivity of electrolytes.

This method was first employed by Kohlrausch and Nippoldt in 1869, and an account of their work and their justification of the method is found in Poggendorff's *Annalen*, CXXXVI. They found that above a certain rate of alternation of the current the electrolytic cell could be replaced by a metallic resistance, and that the value of this replaced resistance did not alter on increasing the rate of alternation.

Two things they considered were necessary for the complete removal of the polarisation effects:—

(*a*) A sufficient rate of alternation.

(*b*) Electrodes of considerable area; small platinised platinum electrodes were afterwards found to answer perfectly well.

The alternate current was produced by a sine inductor, and as an indicator they employed a dynamometer.

In the October number of the *Annalen* for last year there is a long paper on Kohlrausch's most recent work; the method is the same as that employed in the earlier work, only the dynamometer is replaced by a telephone as an indicator.

A modification of this method was used by Ewing and Macgregor. They employed the Wheatstone bridge arrangement, the current being alternated by a rocker.† They do not, however, appear to have obtained any satisfactory results.

More recently Macgregor has replaced the rocker by a double commutator. By one-half of the commutator the alternate current has been produced, and by the other the current of the galvanometer circuit has been redirected, so that through the galvanometer there is a direct but intermittent current. It is a method similar to this latter that I have employed.

My commutator, which was very carefully made by the Cambridge Scientific Instrument Company, consists of a drum, on the two faces of which are eight sectors of brass separated by strips of ebonite; the alternate sectors are connected with two brass rings on the spindle of the commutator. The only difference between the two faces of the drum is that on the one side the sectors are smaller and the ebonite pieces bigger. This is to permit of the galvanometer circuit being broken before the battery circuit, and made after it.

The two rings on the one side of the commutator are connected by brushes with the poles of the battery, and two brushes carry off alternate currents from the face of the drum to the two points

* Read before Section A of the British Association at Birmingham, September 7th, 1886.

† Prof. Ewing traverses these statements. See B.A. Report for 1886.

on the Wheatstone bridge. The brushes are kept firmly pressed in contact by springs.

The two points in the bridge for the galvanometer are connected with two brushes in contact with the other face of the commutator; and, lastly, two brushes in contact with the other two brass rings carry off the direct current to the galvanometer.

The resistance box employed is one of Elliott's, being a legal ohm box; the galvanometer is a Thomson reflecting galvanometer, only the light mirror has been replaced by a piece of mirror glass, which is loaded with several lead discs, and to the back is fixed a small magnet. The magnet has thus a considerable time of swing, and was found to answer much better than the usual light needle. The resistance of the galvanometer was about 268·8 ohms.

Two different cells were employed to hold the electrolyte. The first was similar to that of Kohlrausch—a strong glass beaker, in which the electrodes were kept in fixed relative positions by two small glass plates. A thermometer was inserted between the two plates to register the temperature.

Kohlrausch, to determine the resistance capacity of his cell, measured its resistance when filled with pure mercury;* but he does not mention his having taken any precautions as to the difficulty of getting a good contact between his platinum plates and the mercury. Recent observers have stated that there remains a film of air between the platinum and the mercury, and that to get good contact the cell should be filled under greatly reduced pressure; and even then I have found that the resistance may vary. I have, therefore, not employed mercury to determine the resistance capacity of my cell, but a standard solution of copper sulphate, the absolute values of which I determined by means of my other cell.

This consists of a glass tube of considerable cross-section which fits into two glass end-pieces; the tube has been ground so as to protrude about an inch into the end-piece. The apparatus was made for me by Messrs. Powell, of Whitefriars Glass Works, and possesses the advantage of being entirely of glass, without any corks, &c. And the electrodes were firmly pressed against the ends of the tube, and so the resistance of a given column of the solution determined.

For electrodes, in the first instance, copper plates were platinised. For a long time no satisfactory method of platinising could be found; that which gave the best results was the electrolysis of a solution of platinum chloride and nitric acid; the deposit thus obtained was fairly adhesive.

It was finally found best to obtain some platinum electrodes, and for this purpose two platinum shoes were made by Messrs. Johnson and Matthey, into which fitted thick copper plates; thus a strong electrode of small resistance was obtained without the expense of thick platinum plates; these plates were slightly platinised as above described.

In the early experiments with this method no satisfactory results could be obtained. When the electrolytic cell was introduced into the fourth arm of the Wheatstone bridge sometimes the galvanometer would not give any steady deflection, and it was impossible to get a balance. This was similar to Macgregor's experience: he states that by introducing another cell into one of the other arms of the bridge he readily obtained a steady deflection. In my own case this did not in the slightest diminish the effect; even with a metallic resistance in the fourth arm of the bridge the same value could not be obtained as when the commutator was not working.

Under these circumstances it became necessary to thoroughly investigate the action of the commutator. At first the commutator had been lubricated with a small quantity of oil; this was found to be partly the cause of the effects observed, and it was consequently thoroughly cleansed from all oil.

It was also found that the commutator did not run perfectly steadily; the commutator and its stand were therefore firmly fixed in position with wooden props, and driven by a water engine, which was supplied with water from a tank at the top of the building, and thus a constant and steady speed was obtained.

Finally, as above described, the light needle of the galvanometer was replaced by one with a longer time of swing.

With these alterations it was found that the galvanometer gave a steady deflection, and the method appeared to be satisfactory.

This result having been obtained, the apparatus was tested for induction effects. For this purpose a metallic resistance was introduced into the fourth arm of the bridge, and its value determined when the commutator was not working; the value obtained was—

$$R = 19{\cdot}91 \text{ legal ohms.}$$

With the commutator working at varying rates of speed, the value remained the same, and was not altered by changing the battery power from that of two Leclanché cells to a tray of 10 Daniells. This seemed satisfactorily to show that there was no induction effect, though the sensitiveness of the galvanometer was diminished.

The diminution in the sensitiveness of the galvanometer when the commutator was working may be seen from the following series of observations.

The above metallic resistance being in the fourth arm of the bridge, a balance was obtained when the value of the resistance of the third arm was 1,991, the value of the other two arms being 1,000 and 10 respectively.

(1) Commutator at rest—

Galvanometer zero 28·3 cm. } deflection of 16 mm.
50 ohms in 3rd arm 26·7 }

Zero ... ... 28·3 } deflection of 32 mm.
– 100 ohms ... 25·1 }

(2) Commutator working—

Zero ... ... 28·5 } 5 mm.
– 50 ohms ... 29 }

Zero ... ... 28·5 } 9 mm.
– 100 ... ... 29·4 }

Hence the sensitiveness of the galvanometer is decreased by about two-thirds when the commutator is working, though the rate of driving did not appear to affect the sensitiveness. The apparatus was then tested for polarisation effects. For this purpose the two wires leading from the commutator to the battery circuit were connected with the galvanometer and an electrolytic cell with platinum plates containing copper sulphate; the commutator was started and the circuit completed, the battery consisting of two Leclanché cells; the commutator was allowed to run for two hours and-a-half, the rate of alternation being about 120 per second; at the end of this time the circuit was broken, and the platinum plates washed, treated with hot nitric acid, and ammonia added after neutralisation with ammonia carbonate. There was not, however, a trace of blue colouration; it was therefore clear that no copper had been deposited on either plate, and that there was no cumulative polarisation effect.

This test was again repeated, the platinum plates being replaced by platinum wires, and the Leclanché cells by a tray of 10 Daniells; the commutator was allowed to work for over three hours at the same rate of 120 alternations per second. At the end of this time the wires were treated similarly to the plates, but with the same result. This latter was a more severe test, and would tend to show that the method may be expected to be free from all polarisation effects, and to give satisfactory results.

So far, therefore, this method seems perfectly satisfactory, and with the arrangements as above described, I have not found it in the least necessary to have a second cell in the bridge, as did Macgregor.

I find that the steadiness of the galvanometer depends—

(1) On the commutator being perfectly clean.

(2) On the commutator being driven at a steady speed, though permanent alteration in the rate of speed does not affect it.

Having thoroughly tested the method for polarisation and induction, I proceeded to examine into the question of contact resistance, a subject which has been raised lately by Dr. Gore, several papers on the subject being published in the *Philosophical Magazine* for this year.

It seemed that if there was such an effect as contact resistance it was impossible to obtain the absolute values for the conductiveness and resistances of different solutions, and that before proceeding to the measurement of these quantities it was necessary to test for contact resistance.

For this purpose I filled one of my cells with copper sulphate solution, and determined its resistance value with different pairs of electrodes.

These were—

(*a*) Platinum plates (slightly platinised.)

(*b*) Platinised copper electrodes.

(*c*) Amalgamated copper electrodes, or copper electrodes with freshly deposited copper surface.

I found that the amalgamated copper electrodes left in a solution of copper sulphate became coated with a film of copper, mercury apparently going into solution; this, of course, was only to be expected from the chemical ideas of mass action.

The values obtained were—

(*a*) Platinum electrodes, 469·2 at 16·9°.

(*b*) Platinised copper, 469 at 17°.

(*c*) Copper electrodes, 471·95 at 16·7°.

These same copper electrodes gave after standing in air or copper sulphate solution a value much bigger than that of the platinum plates.

Another pair of copper plates, which had been prepared some days, gave the values with a different copper sulphate solution of—

(1) Copper plates, R = 477 at 17·6°.

(2) Platinum plates, R = 465 at 17·4°.

(3) Platinised copper 465 at 17·4°.

It appears, therefore, that the platinum and platinised copper plates give identical values, and it would appear that the value given by copper electrodes with a fresh metallic surface is almost the same; but that due to oxidation in air or in the solution the surface is changed, and as a consequence the resistance value much increased.

This would tend to show that with clean metallic surfaces, and the same solution, the resistance value is the same, and that there is no contact resistance, or at least that it is the same in all three cases. To further examine this question I determined to experiment with a solution of zinc sulphate with

(1) Platinum plates.

(2) Amalgamated zinc electrodes.

Two zinc plates were freshly amalgamated, and left over night standing in a solution of zinc sulphate, and when introduced into the cell they gave a value

$$R = 312 \text{ at } 16{\cdot}4°.$$

The platinum electrodes gave the value

$$R = 280 \text{ at } 16{\cdot}5°.$$

* Prof. Kohlrausch corrects this statement. See B.A. report.

After again standing in the zinc sulphate solution the value for zinc plates was

$$R = 318 \text{ at } 16{\cdot}5^\circ.$$

The same electrodes were then washed with dilute sulphuric acid, to dissolve off the film of zinc or oxide, and after careful washing were introduced into the cell; the value now came down to

$$R = 286 \text{ at } 16{\cdot}5^\circ.$$

In this case, too, it would appear that with a pure metallic surface the resistance value would be the same, whatever the electrodes used.

Such being the case, it becomes very necessary, in the determination of the conductivity of electrolytes, to take account of the character of the electrodes, and at the same time the above observation would point to the fact that with pure metallic surfaces the effect of contact resistance is constant, if it occurs at all.

Again to further test this point, the absolute value of a certain copper sulphate solution was determined by employing two distinct cells.

(1) Cell A: the tube of this cell had a length of 31·4 cm., its mean section being 10·66 square cm.

The copper sulphate solution placed in this cell gave a resistance value or 504·5 legal ohms at 18·1°.

(2) Cell B: the tube of this cell had a length of 24·16 cm. and a mean section of 13·21 square centimetres.

The copper sulphate solution placed in this cell gave the value 306·9 legal ohms at 18°.

The same platinum electrodes were used in both cases.

The values obtained for the resistance of a cubic centimetre of the copper sulphate solution differed by about 2 per cent.

The values being, with cell A

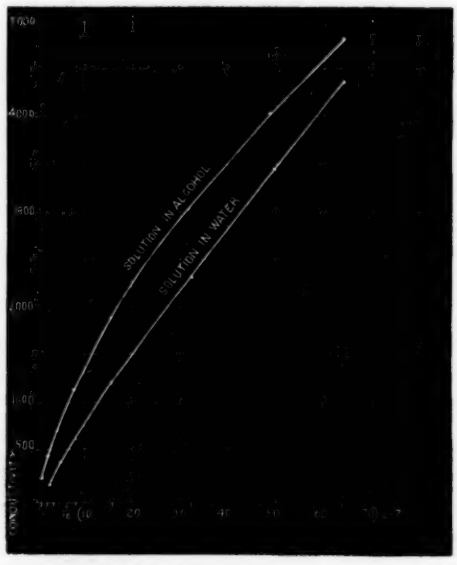
$$R = 171{\cdot}2 \text{ legal ohms.}$$

With cell B

$$R = 167{\cdot}8 \text{ legal ohms.}$$

These results would again tend to show that there is no effect due to contact resistance.

Another point, which seemed of importance, was the action of the solvent in the conductivity of electrolytes, and with the view of experimenting on this subject, solutions were prepared containing the same salt, whilst the solvents were different.



In the first place equal quantities of copper sulphate were dissolved in distilled water and in glycerine, the resistance of the two solvents having been previously determined.

(1) The resistance of 500 cm. of water introduced into the cell gave a resistance of $R = 12{,}780$ legal ohms; in this water was dissolved 6·625 gms. of hydrated copper sulphate; the resistance value was now $R = 8{\cdot}87$ legal ohms at 17·2°.

(2) The glycerine, which was not pure, gave the value

$$R = 181{,}000 \text{ legal ohms.}$$

In this was dissolved 6·625 gms. of hydrated copper sulphate, and the resulting value was

$$R = 27{,}850 \text{ at } 16{\cdot}8^\circ.$$

From these results the conductivity of a solution would appear to a large extent, and in fact mainly, to depend on the solvent employed. The comparison of solutions of copper sulphate in water and glycerine was not, however, continued, as there appears to be some slight chemical action whereby a very small quantity of copper oxide is precipitated; and, hence, it was thought that this would not be allowed perhaps to be a case of solution similar to that of the copper sulphate in water.

The case, however, of solutions of calcium chloride in water and absolute alcohol appeared to be in every way comparable, as a definite crystalline compound of calcium chloride and alcohol exists similar to the hydrated crystalline chloride. For this purpose equal quantities ($\frac{1}{10}$th of an equivalent) of pure anhydrous calcium chloride was dissolved in 500 ccm. of water, and also absolute alcohol (sp. gr. ·795), the resistance of the alcohol and also of the water having been previously determined. Then by dilution solutions were prepared of 250 cc., containing $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, &c., of an equivalent of the salt in 500 cc. of the solvent.

Two series of values were thus obtained for solutions of different dilutions in both alcohol and water, wherein we can compare the action of the two solvents.

Solvent alcohol:—

Conductivity of alcohol at 17·8° = ·00000268.

In each case 250 ccm. of solution was introduced into the cell.

Amount of salt contained in 250 ccm.	Conductivity.	Temperature.
$\frac{1}{20}$ E.	·0007273	18·7°
$\frac{1}{40}$ E.	·0004820	18·7°
$\frac{1}{80}$ E.	·0003055	18·8°
$\frac{1}{160}$ E.	·0001939	18·6°
$\frac{1}{320}$ E.	·0001178	18·6°
$\frac{1}{640}$ E.	·0000729	18·6°
$\frac{1}{1280}$ E.	·0000430	18·6°
$\frac{1}{2560}$ E.	·0000259	18·5°

Solvent water:—

Conductivity of water at 19·8° = ·00000848.

Amount of salt contained in 250 cc.	Conductivity.	Temperature.
$\frac{1}{20}$ E.	·015574	18·8°
$\frac{1}{40}$ E.	·008736	18·8°
$\frac{1}{80}$ E.	·004634	18·6°
$\frac{1}{160}$ E.	·002446	18·4°
$\frac{1}{320}$ E.	·001307	18·9°
$\frac{1}{640}$ E.	·000689	18·9°
$\frac{1}{1280}$ E.	·000364	19·3°

To determine the temperature coefficient of two comparable solutions one-fortieth of an equivalent of dry calcium chloride was dissolved in 250 ccm. of alcohol and water respectively, and the values of the two were determined at two different temperatures.

(1) Alcohol solution:—

$\frac{1}{10}$ E. in 250 ccm. solution in cell gave a resistance value of

236 legal ohms, at 19·4°

250 „ „ „ 13·6°

Increase of resistance of 14 for 5·8° C.

This gives a temperature coefficient of ·00102.

(2) Water solution:—

250 cc. in cell gave value

$R = 14{\cdot}0$ at 18·3°.

$= 15{\cdot}4$ at 14°

Increase in resistance 1·4 for 4·3°.

This gives a temperature coefficient of ·0023.

The results obtained with the two series of solutions have been plotted on curves; that for the water solution is apparently a straight line, and would tend to show that for solutions of such dilution the conductivity is proportional to the amount of salt in solution; the same does not, however, appear to be true in the case of the alcohol solutions.

This is a point which of course needs further investigation, and I intend to experiment further on this subject with different solvents and the same salt.

In conclusion, I have to thank Mr. W. N. Shaw for the kind help and advice he has given me in all this work.

Quantity of salt in equivalents per litre.

In curve for water and $Ca\,Cl_2$ each division measured vertically represents ·0001 increase in conductivity.

In curve for alcohol and $Ca\,Cl_2$ each division corresponds to ·000005.

NATIONAL ELECTRIC LIGHT ASSOCIATION.*

POPULAR PREJUDICE AGAINST ELECTRIC LIGHT WIRES.

By Mr. E. R. WEEKS.

THE long line of martyrs to newly discovered facts gives ample proof of the tendency of man to adhere to the old, and fear and reject the new. Even in this nineteenth century of progress, when invention presses on invention, discovery on discovery, the latest and one of the greatest discoveries feels the impulse of doubt and opposition and popular prejudice, the old summation of ignorance cries out against the electric light.

* Meetings held at Philadelphia, from February 15th, 1887.

It is true that the superiority of the illuminating properties of electricity has brought about its use to a remarkable extent, yet the prejudice against the methods of general distribution bids fair not only to hinder its wide-spread adoption, but to result in legislation that may retard our industry or burden it so heavily that the small beginnings upon which we must depend for the general diffusion of electric light, will be prevented by the great cost of construction and maintenance.

It behoves us then to inquire into the causes of this prejudice and to discover its remedy. It must be admitted that there is an element of danger connected with our business. But the same is true of all modern devices that have materially assisted progress. Now that we fully comprehend the power of steam, we can only wonder that its applications met with no more opposition than they did. But every one thought he knew what steam was, while electricity is an unknown invisible agent, which the popular mind holds in awe, nearly akin to that which led the ancients to propitiate the God of thunder.

The element of danger is, therefore, magnified to vast proportions, and this result, combined with another ignorance of the nature and laws of electricity, makes a strong case against a force in regard to which the wisest have much to learn.

To realise the feeling of the public toward this industry, consider our chances as dependent before a jury in an action for damages to life, limb or property. Were the jury chosen even from the average of intelligence, instead of from the usual stratum, the chances of a verdict for defendant would be but one in ten thousand, though all the expert testimony were clearly against the plaintiff.

Again, this element of danger has been increased by careless workmanship and negligent maintenance. Unavoidable ignorance of the best methods of managing machinery, running lines, &c., has led to much unsatisfactory service and some loss of life and property, though in an insignificant proportion when compared with that which attended the early history of gas and steam. But these causes can no longer be pleaded as an ample excuse, for, although no system of electric lighting has attained perfection, the safest and most efficient methods of construction are well known, and the poor workmanship seen in the lines in many of our cities, the temporising resorts and money-saving devices in an industry that needs perfection in all its parts, prove that complaints against us are not wholly without foundation.

Much of the popular prejudice against electric lighting apparatus is the outgrowth of the opposition that this branch of electric industry has met with from gas interests, and in quarters from which we had reason to expect a most kindly welcome and considerate treatment. It is true that light wires conveying currents of high tension, or enormous quantity, are not very desirable neighbours for either telephone or telegraph lines, but the commodity they carry is just as valuable to commerce, and to the convenience of the public, and has the same right to existence and to accommodation as have the "great conversers" of the present age. It might seem strange that we have met with such opposition and unkind treatment from our cousins in these kindred industries. Yet from time to time we find newspaper articles and reportorial interviews with telegraph and telephone men, the reliability and animus of which may be judged by the following extract from an interview with a prominent telephone manager, not many thousand miles from Detroit:—

"How about electric lights?"

"Well, that's a different thing. The arc circuit, in which the most brilliant lights are placed, is a constant danger when the lights are burning. There is present in the wire itself sufficient electricity to kill any man. You don't have to wait for lightning to come along. The lightning is there. Many a lamp trimmer rues the day, and the chance for paralysis of the man who handles electric lights are a thousand to one. In the case of a man who handles telephones? Yes, there have been a number of fatal cases in that line of business. I know one man who used to trim the lights on top of the 150 foot mast in Union Square, New York. One day he was trimming the lamps, and some people who were watching him saw him topple over and fall to the ground. It was not a mismove; it was a let-go. Well, the company said he had heart disease, or a fit; but it was just electricity that killed him. I think, though, that the greatest danger is in case of a fire. I have known a number of firemen to be knocked down and quite severely hurt at fires by the electricity from the electric light wires. The fireman may be holding the brass nozzle of a hose, and the water may be striking a wire through which a strong current is passing. Presently the wire breaks, or some one turns off the electricity, and the current will run down the stream of water and pass through the body of the fireman, and perhaps seriously injure him. These conditions are not unusual at a fire, and are impossible for a fireman to guard against. It is really far more important that electric light wires should be put under ground than either telegraph or telephone wires. It would interfere far less with the former business than with either of the latter."

Such a tissue of mis-statements and rank ignorance seems to those who know the truth to need no refutation. But the masses have no technical knowledge by which to judge of the utter falsity and absurdity of the whole thing, and, therefore, the result in forming public opinion is highly prejudicial to our interests; for people are willing to have their fears fed by those who will.

If these are some of the chief causes that have led to the popular prejudice against electric light lines the remedy is plain.

Let there be better construction in putting up poles and in running wires. Let there be a rigorous exclusion of all makeshift devices. Let the entrances to buildings be made in the neatest, most inconspicuous, and above all safest way.

Let grounds and crosses be rendered impossible, except under circumstances beyond human control. Maintenance should be looked after with such vigilance that the evils attendant upon the necessary crudity of much of our apparatus be reduced to a minimum.

A thorough system of inspection should be instituted in order to quickly detect and correct trouble; complaints from any quarter should be patiently heard and the causes removed as soon as possible; in other words, by the best construction, by ready, constant and obliging attention, we should seek to render the unavoidable imperfections of service and immaturity of our apparatus less apparent.

One of the most weighty causes of prejudice would be done away with if a more fraternal spirit among the various electric industries could be created. All should work together for the common good. Each adaptation of electricity has its special needs, which every other is bound to respect, and nothing is gained by attempts to exclude or hamper any one of them. Each is necessary for the present, and each is here to stay. Each has its own weakness which can neither be hidden nor cured by attacks on the others.

The members of this association may accomplish much in one direction, at least, and that by working for the enlightenment of the general public as to the agent we employ. Only through such enlightenment can we hope for justice, either in the courts or at the bar of public opinion.

As people more fully understand the character and usefulness of this force, its channels of operation, how perfectly it may be controlled, and the many advantages of its adaptations for lighting, most of the prejudice against it will disappear.

The telegraph and telephone industries have been fully explained to the public in popular treatises; but we have been somewhat remiss in this respect. The promoters of electric lighting have been so occupied in introducing their apparatus that they have confined their writings to technical journals, and have left the instruction of the public to such teachers as the one above quoted.

The SECRETARY then read a pamphlet prepared by Mr. S. E. Barton, of the New England Insurance Exchange, relating to the subject under discussion. The pamphlet showed that when properly inspected, electric lighting plants are considered by the Exchange the safest of all illumination.

DISCUSSION.

Prof. HOUSTON: Those of us who have traced the progress of electric lighting, know that during almost every decade from some time in 1810 there had been the appearance of the electric light promised, and great things blossomed for a while and drooped. But at this time we may say that electric lighting has come to stay. It has come to stay because to-day it stands without any rival as a general artificial illuminant. It is better because it is more like sunlight; it gives a more general illumination; it is less fatiguing to the eye; it is better from a hygienic standpoint; it does not poison the air of the rooms, and I take also the stand that it is better because it is more reliable and safer than any known illuminant. It is safer to both life and property. When we contrast the electric light with the old torch; when we contrast it with the tallow candle, the coal oil lamp and the gas jet which have successively replaced one another, I think that we can all agree that, contrasted with them, it stands number one, head and shoulders above any one of them on the score of safety to both life and property. Our insurance friends will correct me if I am wrong when I say that the friction match which the electric light entirely replaces, or the uncovered gas jet, or the explosive and easily overturned coal oil lamp have been a greater destruction to both life and property during the last year than the electric light; and yet the electric light is a child of comparatively few years of age and other systems of artificial illuminations have been in use for a long time. Of course we must recognise that the electric light possesses dangers; that it will kill if one is stupid enough to permit the current to pass through his body. It will also ignite combustible materials if it is improperly placed. But I assert, and I think you will all agree with me, that there is no necessity in properly constructed systems of electric lighting, of either the people taking the current through their bodies or of combustible materials coming within reach of the electric currents. I know from practical experience that electric lighting can be made safe. This was tested and exemplified at the International Electrical Exhibition. We did not adopt the rigid rules adopted in England and yet in a frame building we had innumerable circuits containing 3,000 volts of electromotive force, and thronged with visitors, and neither was the building burned nor was there any loss of life. So we can testify that the electric light is safe. I think we should insist upon the fullest degree of inspection that our insurance friends can ask, as it is our only safety. We are not running a system that we need fear the most careful inspection of, if we only could agree among ourselves to put in the very best work, use only the very best materials, adopt freely all the well-known and well-tried danger preventives, either from fire or from loss of life, and then I do not think we need fear what the future may have in store for us. I do not think by any means that the dangers will be all removed when the electric wires are all put underground. On the contrary, as the result of very careful thought, I am confident that the time will

come when from expansion or leakage, oxidation or an earthquake, or when the sewer gas escapes, and this will always take place more or less, and you cannot keep it out, then it will inevitably some day bring about contacts, and then they will be contacts of the most glorious character! Contacts that may at a moment reach different and widely separated parts of the city and place them in danger. I do not think that the problem is going to be solved as easily as many of our friends seem to think. Out of sight, out of mind. Therefore, I cannot agree with the conclusions when it is urged or hoped that the time will come when all the wires will be underground. I suppose the time will come, and must come necessarily, when all the electric wires will go underground, but I do not think anything has been shown of a scientific character which proves that the system has been perfected whereby we can safely go underground. It seems to me that it cannot be successfully done with a conduit, but you must have a subway. When you have that, the question of the underground wires will be settled. I only wish to say one thing else. It has often been remarked by people coming from England and other countries that America has made great progress in lighting, more, probably, than any other country in the world, and it is for the very simple reason that, thus far, the electric lighting companies have been let alone and have not had their hands tied, and restrictions have not been thrown around them. But if the laws which prevail in England in reference to the matter are enforced here, then the progress of arc lighting in this country will be barred. I cannot agree with the statement as to its being unquestionably true that converters are necessarily dangerous; or that high-tension electric light circuits are necessarily dangerous. They are more dangerous than others unquestionably; the question is whether they can be so regulated, whether such safeguards can be thrown around them as will render it advisable for us to use them. I think such safeguards can be. Now, only one other point; if a law should be attempted to be passed in this country limiting the electromotive force to two or three hundred volts, on the score that a higher electromotive force than that would be dangerous to life, I think we all ought to be ready to answer that question, which seems to be a very difficult one for people who wish to introduce such restrictions to answer. And that is, I doubt very much whether a person taking the electric light current is killed as a result of the current normally generated by the machine passing through his body, but that which kills him is most probably the spark produced on breaking the current contact. Again and again we read of people who turn pale, shiver and all that, and then at the moment the wire is broken fall down as dead. Why? Because if a machine capable of giving only a few hundred volts has the circuit suddenly broken, there is produced a current of several thousand volts. If that be true you do not gain any advantage when you limit the electromotive force to two hundred volts. You do not make it perfectly safe, but, of course, it is safer than otherwise.

Dr. MOSES drew attention to the fact that provision ought to be made by which a 32 C.P. lamp could not possibly be put in a 16 C.P. lamp socket, as the increased current would heat the wires dangerously. The remedy would be to put a safety catch in each lamp socket.

ELECTRIC LIGHTING AT BRIGHTON.

AT last Thursday's meeting of the Brighton Town Council, the report of the committee with reference to the lighting of the Pavilion rooms and Dome was further considered.

Alderman HALLETT moved a resolution to the effect that the Pavilion Committee should be authorised to obtain tenders for reinstating, in accordance with a specification to be prepared by Mr. W. H. Preece, and approved by Mr. Heaphy, on behalf of the insurance offices, the leads and wires for lighting the Pavilion and Dome by electricity; and also to negotiate with the Brighton Electric Light Company, Limited, with a view to arranging a contract for a supply of electricity, and to report to the council upon the terms and conditions upon which such supply might be obtained. He pointed out that previous reports by the committee had been made with a view to bringing their own apparatus into immediate use in connection with the wires when they were replaced, and proceeded to contend that the price which the electric light company asked, viz., ½d. per lamp per hour, was altogether too high. During their visit to the Eastbourne Town Hall, they saw glow lamps working perfectly steadily, and it was in order to secure a similar degree of efficiency at the Pavilion that the committee proposed to have accumulators. However, they found that at Eastbourne the desired end was obtained by different means. There was an advantage accruing to the accumulators, inasmuch as they would contain a supply of electricity throughout the twenty-four hours of the day for use whenever required, whereas the company made no such promise. They must be careful, therefore, that they did not enter into such an arrangement that they would have a really worse supply than if they had their own accumulators. The formal letter which had been received from the electric light company might form the basis of a contract, if such a step was considered desirable; but, at the same time, he was bound to say that the cost of carrying out the recommendations made by the committee would be less than that which would have to be met if they bought their light from the company.

In the course of the discussion which followed,

Mr. BERRY expressed an opinion that the accumulators, which were, he understood, suggested by Mr. Preece, might be done away with altogether, as at Eastbourne they used "converters" with great success. He was strongly opposed to the Pavilion Committee supplying the light themselves, as he was convinced that they could not do so as cheaply as the company. But for the fact that they supplied some seven or eight thousand lamps in the town, the company would not have been enabled to make such a favourable offer as they had before them.

The motion was eventually carried unanimously.

UNDERGROUND versus AERIAL TELEGRAPH LINES.

(*Concluded from page* 257.)

THE question of placing the system of telephone wires underground is, of course, closely allied with that of underground telegraph lines, but there is the difference that the bulk of the telephonic service has to be carried on over very short lengths of line. The result of experiment has proved that telephonic communication up to at least a distance of 40 miles through the ordinary system of underground work as laid down by the Post Office is perfectly practicable. Although such a length as that named, say 40 miles, is not in actual practice worked through, there is in the district around Newcastle a considerable length of underground work which is in daily use for telephonic communication, this forming part of a long open wire circuit; thus between Warkworth and Stockton *via* Sunderland and West Hartlepool, telephonic communication is carried on through 75 miles of line, including 12 of underground wire, the wire being double throughout. The use of double wire is most essential in cases where the underground circuits are of any considerable length, otherwise overhearing between wire and wire becomes very marked. It is, moreover, essential that the wires should be twisted together in pairs, otherwise the advantage of the loop is to a very great extent lost. In estimating the cost of placing wires for telephonic purposes underground, the use of a double wire would have to be considered, the double wire, moreover, being a twisted one; this, of course, would make the expense heavier than in the case of single wire telegraph circuits.

The possibility of increasing the working distance through underground wires by improving the instruments is not a promising subject, though if this possibility were proved it is probable that the cost of underground wires might be cheapened to some extent by using smaller wires where moderate distances have to be worked through; greater care would, however, have to be exercised in laying such wires from the absence of mechanical strength.

In conclusion we would affirm that the possibility of working a telephonic system underground has passed out of the experimental stage, but whether it is commercially practicable is doubtful even if we take into consideration the light maintenance cost.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(*Continued from page* 251.)

Effects of counter E.M.F. of a motor on the rate of discharge. — The results of experiments which we collected in Tables I. and II., and diagrams, figs. 1 and 2, have given us comparative values of the effects produced upon the E.M.F. of accumulators when the same were discharged at various rates through different external resistances composed of homogenous conductors.

If, instead of discharging the currents through wires

or lamps, we actuate an electro-motor, then the E.M.F. of the battery will vary with the counter electromotive force of the motor, whilst the actual resistance of the external circuit is constant. The current flowing through the motor when its armature is prevented from rotating, will, of course, be $C = \frac{E}{R}$, where E represents the difference of potential at the terminals, and R the resistances of the wires in the machine; but as soon as we allow the armature to spin round the current, C, will decrease, because then the machine begins to work as a dynamo; it will generate a counter electromotive force, e, which is, of course, smaller than E; but the faster the armature revolves the nearer will e approach the value of E, and as this opposing E.M.F. rises, so the current, which we shall call c, diminishes in proportion. The accumulator, therefore, is no longer discharging through the known resistance, R, but against an E.M.F. which has the same final effect, as far as the current rate is concerned, as a resistance of some conducting material inserted between the poles of the battery.

The counter electromotive force we calculate by means of the well-known formula:

$$e = \frac{C - c}{C} \times E_1.$$

To illustrate this phenomenon we have prepared Table VI., giving the results of experiments made with a series-wound motor whose coils offered a resistance of ·4 of an ohm taken between the terminals immediately after running it. Two E.M.F's., therefore, had to be ascertained, viz., E of the battery with only the voltmeter in circuit, and E_1 of the same when the motor was doing mechanical work at the expense of a current, c, measured simultaneously.

TABLE VI.

DISCHARGE THROUGH A SERIES-WOUND MOTOR.

No. of cells in circuit.	Revolutions per minute.	Current c in ampères.	E on open circuit.	E_1 on closed circuit.	Electrical H.P.	Brake H.P.	$\frac{E_1}{E}$	Counter E.M.F. e.
48	1014	31·35	95·5	88·0	3·7	2·8	·921	75·4
,,	720	42·9	,,	85·7	4·92	3·6	·897	68·5
60	1360	31·4	117·6	107·8	4·6	3·6	·916	89·0
,,	950	42·9	,,	104·4	6·1	4·6	·896	86·6
70	1200	42·9	139·6	125·0	7·2	5·5	·895	107·7
,,	1080	47·8	,,	122·5	7·85	6·0	·877	103·4

We commenced with 48 cells, joined in series; these gave 95·5 volts on open circuit; after connection was made with the motor, and the brake loaded to absorb 2·8 H.P. the E.M.F. dropped to 88 volts; the current rate, taken at the same time, was 31·35 ampères. On increasing the load to produce 3·6 H.P. at the motor shaft, 42·9 ampères of current were consumed, when the E.M.F. of the battery fell to 85·7 volts.

Tests were made with 60 and 70 cells in series, and these gave similar results; in all cases when the brake was loaded with weights corresponding to 42·9 ampères, the value of E_1 came to about 89 per cent. of E; and with 31 ampères the E.M.F. on closed circuit amounted to over 91 per cent. of that on open circuit.

We see thus that E_1 is a quantity which varies with the load, and, therefore, in making preliminary calculations, the available E.M.F. should not be fixed as 2 volts, for instance, irrespective of the current rate; indeed, the last experiment, with 47·8 ampères, showed that only 122·5 volts were available out of 139·6 which the battery gave on open circuit. The ratio, $\frac{E_1}{E}$, is tabulated for each test, as also the calculated counter electromotive force of the motor.

Effect of counter E.M.F. of a battery upon the dynamo charging it.—Although a shunt-wound dynamo can only produce a certain maximum E.M.F. at a given speed, yet it will accommodate itself to any counter electromotive force below that maximum. As we increase the number of cells, and with it their counter E.M.F., so the current diminishes until it falls to zero, when, with the least decrease of speed, the accumulator overpowers the dynamo and discharges itself through it, with the result of converting the generator into a motor, running in the same direction. Tests made with a shunt-wound Brush machine proved this conclusively. This dynamo could charge 30 cells at the rate of 22 ampères when making 800 revolutions a minute, but when one extra cell was put in circuit the current dropped to zero, because at this speed the machine could not give more than 68 volts, and the counter E.M.F. of each cell at the time of this experiment was 2·25 volts.

Table VII. refers to this Brush dynamo charging 20, 25 and 30 cells; and table VIII. shows the results of similar experiments with a Siemens machine charging 60, 65 and 70 cells.

TABLE VII.

SHUNT-WOUND BRUSH DYNAMO CHARGING ACCUMULATORS.

Number of cells.	Revs. p.m.	Current.		E.M.F. at terminals.
		Main.	Shunt.	
20	812	28·56	3·00	48·16
25	812	27·37	3·72	59·34
30	800	22·13	4·18	67·94

TABLE VIII.

SHUNT-WOUND SIEMENS DYNAMO CHARGING ACCUMULATORS.

Number of cells.	Revs. p.m.	Current.		E.M.F. at terminals.
		Main.	Shunt.	
60	1161	29	2·9	140
65	1185	23·8	3	147·7
70	1175	17·6	3·45	154

(*To be continued.*)

LEGAL.

Crompton and Kapp v. Anglo-American Brush Electric Light Corporation.—This was an appeal by the defendants in a patent action from an order of Mr. Justice Kay, ordering further particulars of objections to the validity of a patent relating to dynamo machines, on the ground of insufficiency of description in the specification. The particulars amounted to a statement that there was not sufficient direction in the specification to enable a competent workman without further direction and from the specification alone to make the patented machine. It was contended on the part of the plaintiffs that the defendants ought to state in what respect the specification was deficient, and Mr. Justice Kay thought further particulars ought to be given. Mr. Graham, for the appellants, argued that it did not lie on them to tell the patentees in what manner the specification was to be amended, that it was for the patentee at the trial to show that a skilled workman had made a dynamo, such as the patent related to, from the specification alone. Mr. Butcher, for the defendants, contended that in order to prevent the plaintiffs being taken by surprise at the trial, and to be ready with their witnesses, the defendants ought to point out in what respect the specification failed to give sufficient information. Lord Justice Cotton said he should have thought himself that the particulars were sufficient, but it might be that a difficulty would arise when the matter came on for trial, and Mr. Justice Kay, the judge before whom the action would be tried, having taking that view, he thought it better that further particulars should be given. He agreed that it was not for the defendants to point out to the plaintiffs how their specification ought to be framed; but he thought there might be some particular matter in respect of which the defendants ought to state the nature of the deficiency in the specification. It might be that they could or would not give such information. Lord Justice Lindley concurred. Lord Justice Lopes was not present when the case was argued.

INCANDESCENT LAMPS.

THE object of the following remarks is not to dispute legitimate claims, but to help to break down an impression injurious to the electric industry, that recent law decisions have handed over incandescent lamps to a monopoly, whereas it is merely a section of the matter that has been dealt with. The subject is of such vital interest to the electrical industry that no excuse is needed for calling attention to the following points, showing the absurdity of crediting a monopoly to those who followed in Lane-Fox's path, and claim vital features which he had already clearly enunciated.

Now, take the dates of filing patents; Lane-Fox, after a good deal of preliminary investigation and work, filed three patents in 1878, commencing the 9th October of that year.

These patents dealt in the most scientific and accurate manner (a statement which eminent men will endorse) with the essentials of the modern incandescent lamp. Constant potential of mains; high resistance lamps; vacuum; wires sealed in through the glass; even specially naming carbonised material for light-giving media; all this, bear in mind, in October and November, 1878. All the important necessary features for incandescent lamps were enunciated (and for the first time in history) in these patents. Certain details of manufacture alone remained to be worked out, such as standardising, resistance, surface, and temperature. These also Lane-Fox pioneered. For instance, *after* he had filed a patent dealing with these points, Edison stated in a patent which he filed later that to standardise was impossible, and he proceeds to state in that patent how he puts his filaments into a temporary lamp and sorts them out; throwing away some, retaining others.

Lane-Fox's great difficulty was getting durability, owing to leakage, which Edison long after *the* patent of November, 1879 (dealt with in the recent trials), stated was a great difficulty and suggested remedies such as double sealing, vitreous cement, &c., whereas it was merely a question of quality of glass. Now let us examine Edison's ideas on incandescent lighting at the end of 1878. He has three patents, numbers and dates, I think, 4,226, 23rd October, 4,502, 7th November, and 5,306, 28th December, 1878. Take the two earliest first. They describe his tuning fork dynamo, and a lamp formed of a metal coil, which must have been of extremely low resistance and impracticable. He says nothing about the essential features of constant potential, high resistance, vacuum, and sealing in through the glass, as Lane-Fox had done; the two lamps could hardly have been more dissimilar.

The all vital point of constant potential was entirely absent from his mind as is proved by the ingenious and elaborate devices profusely illustrated in his patents for shunting "*the current*" on from the lamp when the easily-fused metal coils became too hot.

Now his third patent of this period is a very remarkable one, viz., 5,306, of 28th December, 1878, for the final specification contains points not even foreshadowed in the provisional. He still describes his metal coil lamps with their shunting arrangements for the current, the idea of constant potential being still entirely absent from his mind when he filed his provisional on 28th December, 1878.

Now between the filing of his provisional and the filing of his final a very important event happened, which was the publication of Lane-Fox's final specification (of his 9th October, 1878, patent) on the 9th April.

A period of about 11 weeks ensued between this and Edison's filing his final.

Now ignoring the effect of certain communications made by Lane-Fox's agents to Edison I believe about this period, the conclusion that Edison's line of thought was changed subsequent to the publication of Lane-Fox's final is irresistible, for he made a dab at high resistance, by saying that he prefers lamps of 1,000 ohms resistance, going from one extreme to another, and also introducing (a point not in his provisional) the use of a constant "field of force" dynamo, still, however, not grasping apparently the vital point of main supply clearly described by Lane-Fox in his earliest patents.

How absurd and unjust to credit Edison with Lane-Fox's inventions, when even at this date the former had never mentioned the now well-known essential features of high resistance, glass sealing, vacuum and constant potential; the fact is, the man who taught Edison and all of us the essentials of electric lighting by incandescent lamps as it exists to-day was Lane-Fox. A perusal of the patents will convince enquirers. I hope I shall not be misunderstood; I have a great appreciation of Mr. Edison personally, and he can well afford with all his renown in connection with many matters to join in giving Lane-Fox his due.

One man does one thing; one another. My wish is not to damage any special interest but to see that go-ahead expansiveness in electric work in this country, which makes electricity in America the immensely popular and profitable industry that it is. This can only be arrived at by a united effort to remove causes which depress, foremost of which is the unfounded idea of monopoly in lamps.

That these points should be fully realised and clearly undertood is of great importance toward clearing the atmosphere of that dread of monopoly which seems to pervade the electrical air, through one side having had all the talking to itself.

RADCLIFFE WARD.

NOTES.

Electric Lighting in Paris.—A suggestion has been made that the Paris Town Council shall establish a municipal service of electric lighting. The police regulations regarding installations of the electric light in theatres and other public buildings are regarded by Paris electricians as much too strict and tending to increase the cost and retard the progress of installation work. All lamps, including glow lamps, have to be surrounded by wire netting, plans of all installations must be submitted to the Prefect of Police in triplicate, and the work must not be begun until permission has been given.

The Lighting of the Brighton Pavilion.—As a result of the visit of Brighton councillors to Eastbourne which we chronicled last week, the Brighton Electric Light Company has been asked to contract for the work of lighting the Pavilion.

Gas v. the Electric Light.—A firm of manufacturers in the town of Glossop has introduced the electric light into its premises. The firm was in the habit of paying about £191 per annum for gas. It has now spent close upon £3,500 on electric lighting plant. Speaking of this installation, the *Manchester City News* says:—"When to this is added the cost of maintenance and the amount payable for the gas, which will still have to be used regularly, in different parts of the mill, it will be apparent that, in respect of cost at least, gas has not yet anything to fear from the electric light." We would suggest to our contemporary that the firm which has thus seemingly plunged into extravagance, has probably acted with its eyes fully open, and with a reasonable prospect of benefitting in some way by the change. Installations of the electric light on a comparatively small scale may primarily be more expensive than gas, but in individual cases there may be counteracting considerations which far outweigh the question of greater initial cost.

Electric Lighting in Germany.—There is a spirit of enterprise abroad in the town of Gelsenkirchen, a number of whose inhabitants have formed themselves into a company with a capital of £12,500 to light the town by electricity.

The Electric Lighting Act Amendment Bill.—The report of amendments to Lord Thurlow's Bill was brought up in the House of Lords on Monday and agreed to. Last night was fixed for the third reading, when also Mr. Hugh Watt's Bill in the House of Commons was to be submitted for second reading.

The *Gas World* will not be sorry to see the 27th clause of the Act of 1882 modified or repealed, "because electricians will not then be able to quote it as the cause of the slow progress electricity is making as a popular illuminant." Our contemporary thinks, however, that should the measure which has now passed through the Committee of the House of Lords be accepted by the Commons, gas companies and gas corporations will require to be on the alert, and counsels them, where possible, to themselves undertake the supply of electricity. If the amendment of the Electric Lighting Act, when it takes place, secures no further advantage to the public than the bringing about what the *Gas World* advocates, that is, the provision of a pure gas of high luminosity at the lowest possible figure, it will not have been effected in vain. We, of course, look for still greater things as a result of the change.

The Board of Trade and the Cockermouth Local Board Electricity and Gas Bill.—The Duke of Buckingham and Chandos, as Chairman of the House of Lords Committee on Private Bills, had before him as an unopposed measure on Tuesday, a Bill promoted by the Local Board of Health for Cockermouth, the object of which was to enable the Local Board to acquire on arbitration terms the undertaking of the Cockermouth Gas Light and Coke Company. The other powers sought by the promoters included a permissive authority to supply electricity should the board at any time determine to embark on providing the "light of the future" in the district; but the clauses dealing with this subject were struck out, the Board of Trade having intimated objections to the granting of such powers to the board. Thus emasculated, his Grace passed the Bill, in order that it might be reported to the House.

The Electric Light in Scandinavia.—A proposal is under the consideration of the municipality of the city of Stockholm for lighting the whole town by the electric light. At present the town is lighted by gas manufactured by the municipal authorities under a gas board. The latter body has submitted an estimate of the cost of introducing the electric light, showing a total of £21,500 for the plant, and a sum of £10,500 for acquisition of ground and the working capital. This sum would provide for 4,000 lamps at once, and in the near future twice as many. The price of supplying the light would be three-farthings per hour for lamps of 16 candle-power, with a reduction for large consumers. The estimate further provides for 4½ per cent. interest on the share capital, with an additional dividend of 8 per cent. The lighting would in all probability be undertaken by the city, but it is doubtful whether the plan will be carried as a considerable sum of money was expended on the enlargement and improvement of the city gasworks a few years ago, and this concern gives a profit considerably exceeding the estimate for the new one. It may be mentioned that it was the latter circumstance which caused the authorities some years ago to decline the offer of a well-known English company to light the city by gas. The municipality has voted a sum of £350 in order to enable the gas board to carry out experiments with hydrogen gas, for the production of which a Swedish engineer has recently invented an oven, whereby its cost is stated to be less than coal gas. Several other Swedish towns have also under consideration proposals for lighting by electricity. Thus the Orebro Gas Company will introduce it into that city through a leading firm of electricians, which is the same case as at Jönköping, whilst at Phillipstad the light will be provided by the European agents of the American firm of electricians, Messrs. Thomson and Houston, who undertake to provide the entire plant required, and light the city for one month, and if it does not give satisfaction to remove the whole without any compensation. The great Borholm Engineering Works have recently introduced the electric light in all their departments, the number of lamps being about 250. The dynamo engines (two) are on the Wenström principle, and the plant has been supplied by the Stockholm Electrical Company at a cost of about £1,000. The motive power is water. The municipality of the city of Christiania has rejected two offers from private firms for introducing the electric light in the Norwegian capital, and has decided upon appointing a committee to frame a scheme for its eventual introduction at the expense of and under the management of that body. The Bergen Electrical Company, to which we recently referred, has gone into liquidation, the municipal authorities having only granted a concession for the introduction of the electric light, without any stipulation as to how long it was to be in force. It is, however, believed that the authorities will follow the example of their Christiania *confréres*, alluded to above.

A Bright Light for Saltaire.—The electric lighthouse, which is to be one of the features of the Saltaire Exhibition, was tried for the first time on Saturday evening last, and with satisfactory results, it being estimated that the powerful beams of light might be seen from 30 to 50 miles away, according to the state of the atmosphere. The lighthouse, as well as the whole of the electric lighting of the exhibition, is provided by the Woodhouse-Rawson Company, of Bradford.

Electric Lighting of Châteaulin.—M. E. Lamy, the managing director of the company for the electric lighting of Châteaulin, has sent us the following particulars about this installation:—The power is supplied by a waterfall developing 45 H.P. The current of a Thury dynamo, giving a maximum output of 180 ampères is conveyed to Woodhouse and Rawson lamps of 10, 16, 20 and 50-C.P. The wire employed is of 100 square millimetres in section, and is supported by poles; the fall of potential varies from 20 to 40 volts, which is of no importance, in consequence of the cheapness of the power. In order to avoid running during the night, a set of 60 E.P.S. accumulators is employed and charged with a Gramme dynamo, giving 220 volts and 38 ampères. The distance between the waterfall and the town is about one mile. Messrs. Paterson and Cooper have supplied the measuring instruments. This installation has been carried out by a local company, and the total cost has been £3,200. The light is given at the price of 2s. 10d. per month per 10-C.P., no meter being employed. A distribution by accumulators will shortly be made by M. Lamy at St. Hilaire du Harouet, the power being given by a waterfall at about two miles distant.

Domestic Electric Lighting.—We understand that Mr. E. Ashworth, of Stayhills, near Manchester, has lately had his house lighted by the electric light. The dynamo is driven by water power from a mill about 400 yards distant, and this mill and another belonging to Mr. Ashworth a mile and-a-half distant are connected by telephone. The whole of the work was successfully carried out by Mr. H. J. Rogers, M.I.M.E., of Watford.

Lighting in Liverpool.—Messrs. Milner's Safe Company, Limited, Liverpool, have recently completed the lighting of their new erecting shop and also the adjoining machine and fitting shop with the electric light, the contract having been placed in the hands of the Gülcher Electric Light and Power Company, Limited. It was decided to light the large erecting shop, which is 310 feet long by 35 feet wide, with six 3,000 C.P. arc lamps placed high up in the roof above the traveller, and to light the machine and fitting shop with seven 2,000 C.P. arc lamps placed in the company's improved

factory lantern, which is fitted with a large reflector and diffusion glass so that it can be used in places where there is little light. After a trial of over two months this method of lighting has proved eminently satisfactory to all concerned. The installation was erected to the specification of Mr. F. B. Welsh, of Manchester, the consulting engineer to Messrs. Milner's Safe Company, who has also advised them throughout the very extensive alterations and additions to the work. The plant erected consists of one No. 4 20-unit Gülcher compound-wound dynamo, giving an E.M.F. of 65 volts at the terminals at a speed of 600 revolutions per minute. The dynamo gives the above output without the slightest sign of sparking on the commutator, and runs perfectly cool when carrying its full load; the machine being placed on a sliding cast-iron bed plate, any slack of the belt is readily taken up. By the dynamo is fixed a very substantial 6 circuit main switch, with cut-outs to each circuit, and also fitted with a negative terminal bar, the whole being mounted on a slate slab, 2 feet by 3 feet, ; from this point the current is led by two main circuits, consisting of $\frac{19}{15}$ cable tapering to $\frac{19}{17}$ and $\frac{19}{19}$ at the ends. This taper cable was specially manufactured by Messrs. Glover and Co., all the tapering being done before insulating; the plan was suggested by Mr. Mountain, the manager of the Gülcher Company, the joints being far neater, and more reliable than they could possibly be if the ordinary method of joining had been adopted. The mains feed, as before mentioned, 6 3,000-candle power lamps, and 7 2,000-candle power lamps. The engine-room and manager's office are lighted with nine 16-C.P. incandescent lamps. In the painting shop a special portable lamp with a wrought-iron stand is used. The lamp is constructed so that it can be held in one hand whilst painting with the other if the work is very intricate, and a light required close to it; but for ordinary work it is placed in the stand. This arrangement has been found most convenient for painting inside large safes or strong rooms, saving all the inconvenience of oil-lamps or candles, besides being more economical. The motive power is obtained from the new engine put down by Messrs. Marshall Sons & Co., of Gainsborough, which is capable of indicating up to 120 horse-power.

Electric Lighting in America.—An effort was made recently by one of the editors of the *Electrical World* to give some idea of the actual investment in the electric light business in the United States. The figures were first printed last January. Since then the Gas Commissioners of Massachusetts have issued their last report, which is, in its way, a strong confirmation of the estimates made as to the investment. At the time of the report of the Commissioners there were 40 electric light companies in Massachusetts in active operation, with an aggregate capital of $3,500,000, and with a capacity of 5,500 arcs, and 30,000 incandescents. This capitalisation, if applied to the total number of lights burning in the country—about 150,000 arcs and 550,000 incandescents—gives a result of a capital stock value of over $70,000,000 for the *local* arc light business, and over $16,000,000 for the incandescent (including isolated plants in each case). In other words, on such a basis of calculation the figures come out about one-third higher than they were put by the *Electrical World* on the basis of average cost of the apparatus, &c., and of the real estate necessary for stations and plant room.

Waterford Telegraph Office.—In answer to Mr. T. Healey, respecting this office, Mr. Raikes said: All the officers consulted in 1881 were of opinion that the Waterford telegraph office should be ranked in List B. In November last I revised the establishment, increasing the number of clerks by two to the present number of four, which was all that the work of the office required. It is not the fact that English offices with a smaller staff have three times the number of superior appointments.

Telegrams to the House of Commons.—The word "Commons" has been registered for telegrams addressed to the House of Commons.

Wire Casings and Mouldings.—Some good specimens of wire casings and mouldings were shown at the recent Building Trades' Exhibition at the Agricultural Hall, by Mr. Samuel Elliott, of the Albert Steam Joinery Mills, Newbury.

Burglar and Fire Alarm.—Mr. Julius Maier requests us to state that in answer to the numerous enquiries he has received about Dr. Taussig's burglar and fire alarm, the apparatus is now fitted up at the offices of Messrs. Pritchard, Morgan & Co., 1, Queen Victoria Street, where it can be inspected on previous notice being given of the intended visit.

Nurse-Electricians.—At the West End Hospital for Nervous Diseases, Welbeck Street, last week, Dr. Tibbits presented certificates to the first students qualifying as nurse-electricians and masseuses. The School of Massage and Electricity was founded in connection with the hospital about five months ago at the request of many medical men, by whom the want of capable nurses, both male and female, in cases requiring prolonged treatment was much felt.

An Italian Torpedo Boat.—A novel torpedo boat, built by Messrs. Yarrow & Co., Poplar, for the Italian Government, was tried last week on the measured mile at Lower Hope, below Gravesend, in the presence of Count Caudiani d'Olivola, Italian Naval Attaché, and Captain Carnevali, and Messrs. Soper and Smale on behalf of the English Admiralty. The boat is the first of two boats ordered, is 140 feet on the water line by 14 feet beam, and is propelled by twin screws and compound engines capable of indicating between 1,500 and 1,600 horse-power. A dynamo-electric machine, driven by a Brotherhood engine, is fitted in the galley compartment for producing the electric light, and also the air-compressing machinery for charging and expelling the Whitehead torpedoes.

Tractive Force on Tram Lines.—When the electric cars are regularly running between Stratford and Manor Park, exhaustive experiments will be carried out to find the tractive force required under the ever varying conditions of working on tram lines. On the evening of Saturday, the 19th ult., a few preliminary experiments were made with the object of discovering what apparatus would be required for the measurements. The spring dynamometers employed were, owing to the vibration of the springs caused by the roughness of the road, deemed unsuitable for very accurate measurements, and in future experiments a hydrostatic dynamometer will be used. The results obtained show that the tractive force on the level does not exceed 20 lbs. per ton at six miles an hour, and further that the ratio of the power given out—that is the total tractive force into the speed—reaches 75 per cent. of the electrical energy given to the motor.

Transformers.—The contributions of Mr. Rankin Kennedy remind us of a transformer used by the late Richard Werderman in 1877-78. He wrapped a thick rod of iron with two insulated wires laid side by side, one forming the primary circuit, the other the secondary. Alternating currents were not employed, but the current from a large Gramme machine of the old-fashioned type was led to an interrupter or make-and-break, and thence to the primary of the transformers. Intermittent currents of any desired degree of rapidity were thus produced.

The Conductivity of Electrolytes.—Mr. Fitzpatrick, at the beginning of his paper "On the application of alternating currents to the determination of the conductivity of electrolytes," speaks of a double commutator used by Macgregor. This appears to be identical with that employed many years ago by the late Sir Chas. Wheatstone for the same purpose.

Helsby Telegraph Works. — Great activity now prevails at these works, and the Telegraph Manufacturing Company, Limited, has, in consequence of the large demand for its goods, commenced to build a large new factory of three storeys—each 150 feet long by 40 wide. In addition to this the company is erecting new battery, insulator, and carbon shops, as also new engine and boiler house. In and around these new buildings will be laid 400 yards of tram lines, together with six turntables and several switches. Messrs. Daniel Adamson and Co. are boilering the new portion, and a Green's economiser will be attached. A new engine of 50 nominal H.P. is being supplied by Messrs. Ruston, Proctor & Co., and is to be fitted with latest improvements throughout. When these buildings are completed the company expects to have one of the finest and most complete telegraph works in England.

Motors for Electric Lighting.—Towards the end of last year the Council of the Society of Arts announced that they would award two gold medals and four silver medals for prime movers suitable for electric light installations, and the nature and conditions of the tests to be applied were published in the REVIEW of December 17th, 1886. The last number of the Society's *Journal* contained the following intimation :—"The Council regret to have to announce that the number of motors entered for the tests which the Society proposed to hold is, in their opinion, insufficient to ensure a satisfactory trial of the motors generally employed for electric lighting. They have, therefore, decided to postpone the competition till next year, in the hope that longer notice may induce a larger number of entries. They now propose, if a sufficient number of motors are entered, to hold the trial in the spring of 1888. Entries will be received up to December 31st of this year. The conditions of the competition will be the same as those previously published, subject to any alteration which may be announced."

Specifications Issued. — Improvements in incandescent electric lamps, No. 4,118, 24th March, 1886, Carl Seel : Improvements in electro-magnetic apparatus for curative purposes, No. 4,280, 26th March, 1886, J. R. Chislett : Improvements in electric arc lamps, No. 4,407, 29th March, 1886, Frederick Thornton ; Electric arc lamp, No. 5,242, 15th April, 1886, J. L. Balbi and Frederick Tolley ; A method of gauging electric currents and apparatus therefor, No. 5,479, 20th April, 1886, S. C. C. Currie : An electric switch, No. 5,606, 22nd April, 1886, W. H. Preece and J. W. Willmot ; Improvements in apparatus for lighting railway trains by electricity, No. 6,586, 17th May, 1886, T. P. Carswell ; Improvements in electric fire alarums, No. 8,475, 28th June, 1886, M. A. Israel and H. A. Israel ; Improvements in apparatus for the treatment of the eyes by electricity for curative purposes, No. 11,844, 17th September, 1886, C. B. Harness ; An improved regulator combined with a portable battery for controlling the light of incandescent electric lamps used for surgical and other purposes, No. 12,779, 7th October, 1886, J. B. Medland ; Improvements relating to electric regulation and to apparatus therefor, No. 168, 5th January, 1887, C. L. R. E. Menges ; Improvements in telephone toll collectors, No. 429, 11th January, 1887, Charles Wittenberg.

The Bazin Primary Battery.—The Brussels correspondent of *Industries* describes a new battery for domestic lighting on a small scale which is being brought out by M. Bazin, whose original apparatus has been fully described and illustrated in the REVIEW. It is a bichromate battery, the electrodes employed being carbon and zinc ; and it differs from other batteries inasmuch as, during use, the carbon plates are slowly revolved in order to clear them from the adhering bubbles of hydrogen. The inventor claims that, in this way, he can maintain the electromotive force at a higher value throughout the time that the battery is at work. The zinc electrode is a circular plate, and facing it are four carbon plates, mounted on a horizontal shaft, which receives motion from a small electromotor by gearing so as to make about two revolutions per minute. The shaft can be lowered or raised, in order to vary the immersed surface of the electrodes. The battery is usually made so as to contain six pairs of plates, and is designed to feed three 6 C.P. lamps for 30 hours. Two such batteries will light six 8 C.P. lamps for the same time ; and four batteries, containing in all 24 pairs of plates, and occupying a floor space of 20 square feet, suffice to light ten 12 C.P. lamps for 30 hours. The small electromotor, which keeps the carbon electrodes revolving, is worked by a portion of the current supplied by the battery.

A Bichromate Soda Battery.—M. Hospitalier has, says the *Gas World*, described in glowing terms the favourable results obtained from a bichromate soda battery as a source of light. His figures prove that the cost is six times that of Paris gas (6s. 8d.), and that for ten lamps there would be every month 7½ cwt. of sulphuric acid, 2½ cwt. of zinc and 2½ cwt. of bichromate of soda to be dealt with. This, our contemporary thinks, would convert each unfortunate private residence into a chemical factory.

Electrical Communication with Lightships.—The question of electrical communication between lightships and the shore, with the object of facilitating the saving of life at sea, is this week being made the subject of inquiry by a committee specially appointed by the Board of Trade for the purpose. The remit to the committee authorises them not only to inquire into the subject of such communication, and report thereupon, but also to consider whether a system of electrical communication should be applied to outlying lighthouses ; whether the experience gained by the experimental cable to the *Sunk* light vessel justifies the cost and is of sufficient value to warrant an extension of the system ; and whether it is desirable that any of the stations to which the system is applied should also be used as signal stations for commercial purposes. The committee is composed as follows :—The Earl of Crawford, Sir Edward Birkbeck, M.P., Colonel King Harman, M.P., Mr. Thomas Sutherland, M.P., Rear Admiral Sir George S. Nares, Mr. Cecil Trevor, Assistant-Secretary to the Board of Trade, Captain J. Sidney Webb, Deputy Master of Trinity House, Captain Hozier, Secretary to Lloyd's, and Mr. Alfred Holt. At the sittings of the committee, which are held in the offices of the Board of Trade, the evidence of several experts has, we understand, been taken. The proceedings are conducted in private.

Stafford-Eaves Dynamos.—At the Volt Works, Coventry, Messrs. Stafford & Eaves are making machines for electric lighting, electroplating, electrotyping, copper refining, and other purposes, which have a new type of field magnet providing a direct circuit of low resistance for the magnetic lines of force. They have a neat and compact appearance, and are said to be simple and inexpensive to construct. The makers supply us with the following particulars of a dynamo they have recently supplied for coppering and nickel-plating :—Weight of machine, 4 cwt. 2 qrs. ; size of armature, 8½ inches by 5 inches ; depth of core, 1⅝ inch ; material of core, charcoal iron rings stamped from No. 20 gauge ; current in shunt coil, 12 ampères ; current in external circuit, 138 ampères ; E.M.F. at terminals, 6 volts ; resistance of machine after five hours' run, armature, ·007 ohm, field magnets, ·5 ohm ; speed of machine, 640 revolutions per minute ; number of circuits between brushes, four.

Electricity and Paper Making.—Mr. H. J. Rogers, of Watford, has invented a strainer for straining paper pulp, the vibrations of the diaphragms of which are actuated by a current of electricity. This will render the strainer perfectly noiseless, which will be a great advantage. The strainer plates are so constructed that no dirt can possibly pass them and reach the paper in course of manufacture.

The Electro-Harmonic Society.—The first Smoking Concert of this newly-formed society took place on the evening of Friday last in the Banquet Room of St. James's Hall Restaurant, Mr. C. E. Spagnoletti, presiding. As many of our readers are aware, the society has been promoted with the object of occasionally bringing together the electrical fraternity and their friends for the purpose of enjoying social intercourse, unencumbered by the trammels of business, and to listen to good music, which hath charms to soothe the savage breast (not an unusual possession in these days of keen competition), discoursed by exponents of proved ability; and, if a correct judgment can be pronounced from the impressions gathered on the opening night, we think that a long-felt want has been supplied. A capital programme had been provided by the musical directors, and the Electro-Harmonic Society listened with evident pleasure to several songs and glees, performed in an admirable manner by Messrs. Dalzell, Kift, Bevan and Brown. Mr. Wilhelm Ganz, whose name alone went far towards ensuring success, most kindly placed his valuable services at the disposal of the society, and played the "Sonata Pathétique" of Beethoven, in addition to some lighter selections. During the interval, Mr. Spagnoletti, who has been untiring in his efforts in support of the society, explained briefly the objects which had brought the members together, and shortly before 10.30 the concert came to a close, amidst general expressions of satisfaction from the assembly.

Personal.—Dr. John Hopkinson, F.R.S., has been elected a member of the Athenæum Club.

Mr. Sinclair, who for the past two years has been assistant to Prof. J. J. Thomson, of the Cavendish Laboratory, Cambridge, in his electrical and electro-chemical researches, has returned to Glasgow, where he received his engineering training, and is now in chambers there as consulting engineer and electrician.

The Canadian Society of Civil Engineers. -- Mr. Frederic Newton Gisborne (member of the Society of Telegraph-Engineers and Electricians) has been elected one of the Council of the Institute of Civil Engineers of the Dominion of Canada.

The Brighton Electric Railway.—A deal of correspondence appeared in the local papers recently with reference to the electric railway at Brighton, and Mr. Volk, in replying to the attacks of his opponents, states that when he started the line he took the whole risk himself, but the opposition has drawn people round him, and, as in the fire mentioned by Bunyan, while his adversaries poured on water in front his friends poured on oil behind. No member of the council has ever had any interest in the concern, and he suggests that if the persons who are so interested in the welfare of Brighton will buy him out—the line has only cost him £3,700—he will stop running and leave the town at once.

Demagnetising Watches.—An American contemporary thus describes a watch demagnetising case made by Messrs. Giles & Co., Chicago, Ill.:—"The plan of this invention is to enclose the watch movement in a perfect circle or box—which is made neat and compact so as not much to increase the size of the case—of highly magnetic metal, the effect of which is to make the space enclosed, in which the watch movement plays, free from magnetic force—a sort of magnetic vacuum—and the force, of whatever degree it may be, is exerted on a circle from without, and equal on all sides. The conditions are constant, so that the watch can be regulated to its best, while a watch unprotected by this device is subjected to all varying magnetic conditions, caused by the earth's magnetic force, and the various electric and magnetic appliances at the present time so numerous. This shield is composed of decarbonised steel of the finest quality, and pure copper and gold, so arranged as to secure the result required, which was accomplished after many tedious and expensive experiments."

Factory Accounts.—Messrs. Crosby, Lockwood & Co. will publish this month a work by Mr. Emile Garcke and Mr. J. M. Fells, on "Factory accounts, their principles and practice," a handbook for accountants and manufacturers, with appendices on the nomenclature of machine details, the Income Tax Acts, the rating of factories, fire and boiler insurance, the Factory and Workshop Acts, &c., including also a glossary of terms and a large number of specimen rulings.

Lecture.—An interesting lecture was delivered by Mr. W. H. Preece at "The Hall," Belvedere, Kent, on Thursday, the 17th ult., on "Electricity and its various applications." Experiments to show the mode of working all the most recent instruments for telegraphy were given, and also practical demonstration in telephony, the transmitter being placed in one of the residences about a quarter of a mile off, and the receiver in the hall. Some electric lights were also exhibited, and Mr. Preece's descriptions were much relished by a large audience.

Boston and Electric Street Railways.—The railroad companies of Boston, Massachusetts, have recently been giving attention to the development of electric motors, and Mr. Calvin A. Richards, president of the Metropolitan Railroad, interviewed on the subject, announced his belief that some other power would take the place of horses in the near future for moving Boston Street cars. The conditions regarding snow and ice were different in Boston from what they were in those localities where electric lines had been laid, but experts professed confidence in their ability to overcome all obstacles. Personally, he considered the storage battery system one of the best, as it called for no alteration of the road bed, and applied its power directly to the wheel of the cars, thus obviating the great waste which must result from using any system where the power passed a long distance through a conductor from a central station.

The British Association.—At a committee meeting held recently at 22, Albemarle Street, the principal officers for the Manchester meeting of the British Association, to begin on August 31st, were selected. The President will be Sir Henry Roscoe, M.P., F.R.S. The presidents of the various sections will be as follows:—Section A, Mathematics and Physics, Sir Robert S. Ball, Astronomer Royal for Ireland; B, Chemistry, Dr. Edward Schunck, F.R.S.; C, Geology, Dr. Henry Woodward, F.R.S.; D, Biology, Professor A. Newton, F.R.S.; E, Geography, General Sir Charles Warren, R.E., G.C.M.G.; F, Economic Science, Dr. Robert Giffen; G, Mechanical Science, Professor Osborne Reynolds, F.R.S. For Section H, Anthropology, a president has not yet been obtained. The Manchester meeting promises to be one of the most brilliant, socially at least, ever held. A very large sum has already been subscribed, and the excursions and other entertainments will be on an unusually liberal scale. One of the public lectures will be given by Prof. H. B. Dixon on "The rate of explosions in gases;" the lecture to the "operative classes" will be by Prof. George Forbes.

Timing Photographic Exposures.—The *Scientific American* of February 19th contained a capital description of Londe's electrical method of timing protographic exposures, extracted from "La Photographie Instantanée," by Albert Londe. A registering cylinder is governed by a Foucault regulator. On its end is placed a bright point, a nickel plated head of a nail, for example. The point and cylinder move together. It is its displacement that is photographed. It moves behind a graduated screen pierced with a segmental opening. The screen is black; the divisions are white. The cylinder is covered with smoked paper, over which an electric tuning fork carrying a light needle point vibrates. A photographic apparatus is focussed upon the dial. The regulator is started, the stylus of the tuning fork is made to touch the paper, and the shutter is released.

Electric Lighting in Belgium.—M. Belpaire, manager of the Belgian State railways, is having trials made with the Ragot petroleum engine, in connection with the proposed electric lighting of the railway station. The experimental installation in the workshop of M. Ramu consists, according to *Industries*, of 100 incandescent lamps and 2 arc lamps of 8 ampères, fed by a dynamo driven by a 6 H.P. engine, which is said to consume from ·75 lb. to ·8 lb. of petroleum per horse power hour. The initial pressure in this machine is very high, and must strain the working parts at the beginning of the stroke; but the light is sufficiently steady. The dynamo is compound wound.—The Café Indien, at Antwerp, is to be lighted by means of 15 arc lamps of 8 and 6 ampères, and 250 Khotinsky glow lamps. One of the new Ragot motors and Gadot accumulators will be used. The installation, which has been undertaken by Mr. Dratz, is to be ready by 10th April.—At Liège, M. Pieper is lighting the Café Canterbury with arc and glow lamps. The Taverne de Munich is supplied with power for its electric lighting by means of a Dulait turbine, driven by water from the town mains. This is one of the first installations in Belgium worked by an hydraulic motor.—M. Gérard, the well known electrician, is using a Davey motor for his own private installation.

Electric Search Lights.—Some important experiments were made on Wednesday night by the French ironclad squadron at Toulon. With the aid of a new reflector, torpedoes were visible 4,000 metres distant.

Lighting Gas by Electricity.—For some time past complaints have been rife at Gosport regarding the dangers to which passengers by the steam launches are subjected at night-time, owing to the imperfect lighting of the landing place. Whenever the weather in Portsmouth Harbour has been a trifle rough, the gas lamps on the Gosport side of the water have fallen an easy prey to rude Boreas, and there has been a conspicuous absence of the *lux in tenebris*. However, the Alverstoke Local Board have determined to change all that, and at a recent meeting it was determined to expend £15 for the purpose of lighting the lamps by means of electricity. It had to be carefully explained that it was not intended to supersede the gas, but merely to provide an apparatus by which the expense of lighting would be obviated, and which would enable any lamp to be re-lighted immediately in case it was blown out. Batteries will be used to generate the electric current at an annual cost of a few shillings. Public bodies at Gosport move slowly, but perhaps in course of time the Local Board may learn that electricity is useful for other purposes besides igniting gas.

NEW COMPANY REGISTERED.

Lancashire and Yorkshire Self-Winding Clock Company, Limited.—Capital £6,000 in £1 shares. Objects: To carry into effect an agreement between the Self-Winding and Synchronising Clock Company, Limited, of the first part, and Messrs. J. Crosfield, of Warrington, F. Myers, of Liverpool, and D. Boyd, of Manchester, of the other part, to acquire certain rights under the letters patent, No. 15,500, dated November 25th, 1884, granted to W. P. Thompson for improvements in clocks, and in apparatus for actuating or controlling the same by electricity, the same being a communication from Chester H. Pond, of Brooklyn, U.S.A.; also to acquire the letters patent, No. 7,548, dated June 20th, 1885, granted to C. H. Pond for improvements in synchronisers for clocks. Signatories (with one share each), D. Boyd, Reform Club, Manchester; F. Myers, 65, Victoria Street, Liverpool; C. P. Bennett, 27, Lombard Street; J. A. Lund, 49, Cornhill; J. F. Sandeman, 52, Queen Victoria Street; P. G. Morrisson, 52, Queen Victoria Street; J. Boyd, 50, Bow Lane. The signatories are to appoint the first directors. Qualification, 200 shares; remuneration, £500 per annum, and 10 per cent. of the amounts divided as dividend in excess of 10 per cent. per annum. Registered 23rd inst. by R. Jordan, registration agent, 120, Chancery Lane. Registered office, 65, Victoria Street, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Sewage Utilisation and Improvement Company, Limited.—The statutory return of this company made up to the 28th ult. shows that of the nominal capital of £500,000 in £1 shares, the only shares at present taken up are the seven subscribed for by the signatories to the memorandum of association, and upon these nothing has been paid.

Union Electrical Power and Light Company, Limited.—An agreement dated February 24th and filed on March 22nd made between the Primary Battery Company, Limited, and this company, cites that the provisional contract of December 13th and the supplemental agreement of January 17th, are hereby absolutely cancelled and at an end. The Primary Battery Company agrees to sell to this company, certain English, Foreign, and Colonial patents relating to electricity; its interest in premises situate in Globe Road, Mile End, held at yearly tenancy, at a rent of £150 per annum; its interest in the premises 127, Cannon Street, held at a rent of £40 per month, and the premises now occupied by the Primary Company at 11, Queen Victoria Street, at a rental of £100 per annum; also plant, stock-in-trade, and other assets. The purchase consideration is £76,500 payable £60,000 in fully paid ordinary shares, £1,500 in cash, £15,000 by the allotment in fully paid shares to certain creditors of the Primary Company in satisfaction of their claims of preference shares.

The statutory return of the company made up to the 18th ult. was filed on the 25th ult. The nominal capital is £500,000 in £5 shares. The only shares recorded as taken up, are the seven subscribed for by the signatories to the Memorandum and Articles of Association, and upon these no call has been made.

An extraordinary general meeting of the company was held on the 4th ult. at the office of Messrs. Linklater & Co., 7, Walbrook, when it was resolved that the capital of the company be reduced to £100,000, divided into 800 preference and 12,000 ordinary shares of £5 each; the preference shares to be entitled to a cumulative preferential dividend of 10 per cent. per annum. After payment of such dividend the remaining available profits are to be divided as follows:—$33\frac{1}{3}$ per cent. to the holders of the preference shares and $62\frac{2}{3}$ per cent. to the holders of the ordinary shares. On a division of the assets in the event of winding up or otherwise, the preference shares are to have priority over the ordinary shares. Messrs. John Gwynne, Hy. Lea, T. Albert Mitchell, Edwd. Montague Nelson, Wm. Barton Wright and B. Birt, the directors elected by the subscribers, together with Messrs. Josiah Glode Stapleton and Thomas John Jones were appointed directors. The special resolutions were confirmed at a meeting held at the same place on the 22nd ult. and were duly filed on the 28th ult.

West London Electric Lighting Company, Limited.—The annual return of this company made up to the 15th ult. was filed on the 23rd ult. The nominal capital is £60,000 in £10 shares. 175 shares have been taken up, but nothing has been paid thereon. Registered office: Winchester House, Old Broad Street.

Liverpool Electric Supply Company, Limited.—The annual return of this company made up to the 21st of

March was filed on the 23rd March. The nominal capital is £200,000 in £5 shares. 3,692 shares have been taken up, upon which £4 per share has been called. The calls paid amount to £14,768, the paid up capital thus showing an increase of £6,480 as compared with the amount recorded in the previous return.

Strand Electric Lighting Company, Limited.—The registered office of this company is at 31, King Street, Covent Garden.

CITY NOTES, REPORTS, MEETINGS, &c.

The Electrical Power Storage Company, Limited.

THE sixth ordinary general meeting of the company was held at the City Terminus Hotel, Cannon Street, on Thursday, Sir Daniel Cooper, Bart., K.C.M.G., in the chair.

Mr. Holland Dell, the secretary, having read the notice convening the meeting, and the report having been taken as read,

The Chairman said: I feel more pleasure in addressing you to-day than on any previous occasion, and my task is an easy one. We have a profit of £35,937 11s. 3d., which enables us to write off the amount standing to the debit of profit and loss, viz., £22,412 6s. 9d., and to carry forward a balance of £13,525 4s. 6d., and I am not aware that any company engaged in similar business has done so well. The largeness of this profit may have caused some surprise, and I would mention that a considerable portion of it is of an exceptional character, and occurs through some interests becoming marketable since the date of the last balance sheet, the value of which we felt bound to include, but, on the other hand, a substantial amount of it is trading profit. We have got rid of the evil legacies of past years, that is, the debit balance in the profit and loss account, and are going forward with a clear sheet, when whatever we make can be divided among the shareholders. It is natural for some of you to wish to know why, with this large profit, the directors do not propose to recommend a dividend. The reason is, that with the increasing business of the company, and the amount of capital required for carrying it on successfully, we must not diminish our cash working capital. I will now comment briefly upon some of the subjects dealt with in the directors' report. I am glad to say we have had no litigation in England during the past year; there has been no necessity for any. But we have carefully watched and shall continue to watch all those who seem inclined to interfere with your property. You are aware that this company owns a numerous group of patents, among which are the first patents granted for secondary batteries; and I only call attention to what is a matter of public observation in saying that the obvious tendency of recent patent decisions has been to increase the value of our patent rights. In addition to the license granted last year to the Elwell-Parker Company, we have granted a license to the Edison and Swan United Electric Light Company to manufacture certain types of secondary battery plates; and we have taken similar steps in other directions with the object of urging forward the application of accumulators to the propulsion of tramcars, which branch of business is beginning to attract the attention it deserves. The successful adaptation of this company's batteries in the electrical launch attached to the steam yacht *Northumbria*—where some of the cells placed in the launch itself supply motive power for the launch, and are also capable of furnishing light when desired—should induce the extensive use of batteries for this purpose. Train lighting by electricity I take much interest in, and I expect to see this year a considerable development of this branch of electrical work. I feel sure that the public will appreciate the efforts of those railway companies who are desirous of adding to the comfort of passengers by materially improving the lighting of their trains. The lawsuit in France has not yet come on for hearing—it will, probably, during the summer. Negotiations have been begun and will be continued on the Continent for the purpose of getting local people to interest themselves in the accumulator business. The value of secondary batteries is gradually becoming recognised throughout Europe. In Germany the claim made against the Faure patent is still before the courts. Our attention has been called to several secondary batteries on the Continent, and we have examined into them: they have no special merits, and the principal ones are obvious infringements of some one or other of our patents. The installations at the various banks and offices mentioned in the report were successfully carried out after our last meeting, while the older ones, such as the Bank of England, the Peninsular and Oriental Steamship Company, the Bank of New South Wales, Lloyd's, and many others continue to give satisfaction. We are supplying accumulators to the Admiralty and War Office, and we number among our customers several Foreign and Colonial Governments. We are determined to keep well ahead in our work, and our technical staff, under the direction of Mr. Frank King, our superintending engineer, have for several months past given the closest attention to certain details of manufacture, with the view of securing the highest excellence, and such improvements in the batteries as may be possible. You will have read, doubtless, with pleasure, the description of the position and progress of the Electrical Accumulator Company in New York. It is just what I should expect from a sound exterprise, when handled by such a man as Mr. Vail. They have the advantage in the States of not being unduly fettered, as we are in this country; but the Bill of Lord Thurlow has been so well received by the public, that, backed by the powerful support of the Prime Minister, Lord Salisbury, I think the electrical industry will be granted a considerable measure of relief during the present Session. I beg to move the adoption of the report and accounts.

Mr. J. S. Sellon, in seconding the resolution, said there was one matter to which he would call their attention, as it bore upon the value of the company's property, namely, the position of the patents. What made the subject perhaps of special interest just now was that in a prospectus recently before the public professions of so extraordinary a nature were put forth that many large shareholders were quite staggered until he was able to assure them that the statements in questions must be accepted with a great many grains of salt, that the *modus operandi* proposed, namely, the distribution and supply of batteries from house to house, was impracticable, and that, holding, as the company did, a complete group of patents which together covered every practical and successful form of secondary battery, their position was fully protected. Even supposing that the company in question could succeed in establishing the business of supplying electrical accumulators, they must eventually come to them for licenses, and this was a point upon which the directors held liberal and business-like views, knowing that the ground to be covered in such work was rapidly extending, and that there would be room for many in it. They held what might be made a practical monopoly, a gigantic monopoly, but it was not perhaps good policy to throw impediments in the way of the development of such a business as this might become, so long as their rights were recognised and protected. It had been suggested that the present form of secondary battery might be superseded, but all that was at present known went to prove that that was not at all likely to be the case. The subject was one of such great importance that it had exercised the minds of the most talented electricians of the world; still, as they all knew, no material new departure had been as yet made from the principles which were laid down in 1881 by Faure, Swan, and himself. The shareholders, therefore, might feel assured that the essential principles, at any rate, of secondary batteries were covered by the company's patents, and that though it might be possible that minor improvements in details might be arrived at, yet if such improvements were made by outsiders naturally they could be brought within this company's control. He had had some satisfaction in feeling that every statement by him years ago as to the development and future use of secondary batteries, which were then thought little of, had been more than justified by the extension of their use which had now taken place; and with the great strides which were now being made in electrical work throughout the world, they were being found to be more and more indispensable. It was now fully admitted that no domestic electric light installation was complete without them, that they were not only essential to comfort and convenience and for securing reliability and continuity of the light at all times, but that greater economy was effected by their use. With regard to the point of reliability, no doubt most of them read in the papers of the consternation and inconvenience caused by the light giving out in the Houses of Parliament about three weeks ago, and how bits of candle had to be hunted up and light improvised in every possible way. There was an instance of an installation put up with the greatest care, all the machinery, he believed, being in duplicate, giving out for want of a set of accumulators. The public would not put up with failures of that kind, and unless accumulators were used they might be quite sure electric lighting would not extend in the way they at present believed it was going to. The work initiated at great cost by the company in showing the utilisation of batteries for tramways was now about to bear fruit, and this, with other developments, must bring about the success which they must all feel the company deserved.

Mr. Schomberg wished to know approximately what they might assume was the net profit upon their own working. The balance sheet showed a profit of £35,937, but there was an impression that some portion might have arisen upon royalties and the sale of patents. Having suggested that the directors should consider the advisability of paying an interim dividend, he pointed out the inconvenience to the shareholders which arose from the fact that there was no official quotation of the company's shares on the Stock Exchange. Speaking of the competition to which Mr. Sellon had referred, he said he might state that a gentleman of considerable legal position had expressed his opinion that the specifications of the company's patents were so skilfully drawn that it was almost a moral impossibility that they could be superseded.

Mr. Ackery said about £27,000 out of the profit of £35,000 appeared to be exceptional. He saw that £130,000 was put down to patent account; this was a considerable increase upon last year's account, and he wished to know whether the difference represented cash received, or whether it was merely an amount carried into the account as the supposed additional value of the patent.

Mr. Courtenay, the managing director, replying upon the points raised, said he last year had an interview with Mr. Burdett, of the Stock Exchange, with reference to securing an official quotation, but the objection to granting the quotation was that certain of the shareholders held a large number of shares. The company numbered between 500 and 600 shareholders, and he told Mr. Burdett that it was scarcely right to expect those gentlemen who had large holdings to sacrifice their shares at a low price for the sake of a quotation. They would renew their efforts to induce the

Stock Exchange Committee to give them a quotation, and he hoped they would have the support of the shareholders. A large portion of the profit was of an exceptional character, but there was also a considerable trading profit. The patents account included several items and certain interests which had not become important until the past year, but it was with the approval of the auditor that they were classed together under that account. The company was not, as many seemed to suppose, merely a manufacturing concern. They had a variety of interests, and thought it unnecessary and injudicious to publish more minute details of their business than were given in the report and statement of accounts. He was glad to say that all their different sources of income had given an increased revenue during the past year. With regard to what Mr. Schomberg had said as to dividend, all he could say was, if they had sufficient working capital they could pay a dividend that day, but they were in the position that, when the demand for accumulators was greatly increasing, their working capital was too small to enable them to meet the demand, and but for the action of the directors in lending something like £12,000 of their own money to the company, they would not have been in the position they were that day. That liability must be wiped off before a dividend could be paid, and he could assure them that the directors were quite willing to pay a dividend as soon as it should be possible, for they were by far the greatest holders themselves.

Other questions of account having been discussed, the motion for the adoption of the report was put and carried.

The retiring directors and the auditors having been re-elected, a cordial vote of thanks was passed to the chairman, and the meeting terminated.

Direct Spanish Telegraph Company, Limited.

THE twenty-seventh ordinary general meeting of this company was held at Winchester House, Old Broad Street, on Monday last, under the presidency of Sir James Anderson.

Mr. Ch. Gerhardi, the manager, having read the notice convening the meeting, and the report (which was published in the REVIEW last week) having been taken as read,

The Chairman said the expenditure for the half-year had been £22 more than that for the previous half, but it was £200 less than the expenditure for the corresponding half of 1885. This was owing entirely to the increase of traffic, which necessitated more stationery and a little more salary. Since the last meeting they had been in the Law Courts, and had reduced the capital by one-half. They had now a quotation on the Stock Exchange, and he believed the position of their affairs had given very general satisfaction to the shareholders, for with two or three exceptions they had all signified their assent. Two gentlemen had been rather hard upon the directors. They scarcely objected in what he could call a friendly spirit. But he had some sympathy with them, for he himself entertained for a long time a feeling that it was a very hard thing to do to reduce the preference shares in the way they had done. After anxious thought and great consideration had been given to the matter, they found they could not help themselves; the law stood in the way and said, "You shall only do it in a given fashion," and they had to go to the courts to see how it was to be done. One judge did not agree with them and did not sanction their plan of reduction, but he did not say what other plan they should adopt and did not say anything which appeared to them to establish law on the subject. They were advised by their counsel and solicitor that they were as much in the dark as ever and that they ought to appeal. They did appeal, and the judges in the Court of Appeal fully confirmed all they had proposed. Assuming that the Court of Appeal had taken the same view as the first judge took they would not have been any better off; they would still have been obliged to go into court to learn what they were to do, because they could not, as the law stood, have paid any dividend at all until they had recouped their lost capital, for their assets were positively lost to the extent named in the resolutions which were passed. Well, they had reduced the capital, the preference shareholders had had £5 taken off from their £10 fully paid up and the ordinary shareholders had had £5 taken off from their £9 fully paid and still had a liability of £1 per share, so that they had £13,000 in hand to support the property in the interests of the debenture holders and the preference shareholders. This was remarked upon by one judge in the Court of Appeal as being a little hard on the ordinary shareholders; so that while they were sympathising with the hardships of the preference shareholders, the judge, who knew more about these matters than lay people, was sympathising with the ordinary holders. Taken altogether, they had got into a very fair position; they had a going concern, a marketable security earning a dividend and likely to continue doing so. At the last Berlin Conference their tariff was reduced to a very low figure, but notwithstanding that, thanks to the commercial treaty, to some revival in trade and to the reduced capital, the number of messages had increased by 26 per cent., and their earnings had increased by 6 per cent. He looked forward to being in a position at the next meeting not only to lay by a substantial sum to reserve, but also to pay the accumulated interest on the preference shares and a dividend of 4 per cent. on the ordinary shares. Of course, he could not say there would be a dividend of 4 per cent.; that depended on the traffic keeping up. Just now they were fairly satisfied, having earned £300 more in the first three months of this year than in the same time last year; that increase, upon a small capital, was a great deal. The tendency in these days was to force private companies down to the smallest revenue and the smallest tariff that the public could possibly get, and he hoped and believed they had gone to the lowest point they were likely to reach; that being the case, he congratulated them and congratulated himself on possessing good security in this company.

Mr. E. Etlinger seconded the motion, which, after an unimportant discussion, was carried unanimously.

Mr. Etlinger and Mr. John Denison Pender were re-elected directors, and the auditor, Mr. Herbert Duke, was also re-appointed; a vote of thanks to the board thereafter terminating the proceedings.

Montevidean and Brazilian Telegraph Company, Limited.

THE ordinary general meeting of the shareholders of this company was held at the offices, Tokenhouse Buildings, on Thursday last week, Dr. Cameron, M.P., presiding.

The Chairman moved the adoption of the report for the year ended December 31st last, which stated that the percentage of gross revenue receivable from the Western and Brazilian Company showed a gratifying increase, being £2,370 as compared with £1,529 in 1885. There had been a continuous improvement in the traffic since the end of March, and the revenue had been favourably affected by the higher rate of exchange which had prevailed, the average being 20¾d. per milrei in 1886 as compared with 18¾d. per milrei in 1885. The directors were glad to observe that, so far as could be judged from the published returns of the Western and Brazilian Telegraph Company, the improvement in the traffic appeared to be fully maintained during the current year. The balance to the credit of revenue account amounted to £1,180, which, after making the usual provision of £500 for redemption of debentures, would enable the directors to recommend a dividend at the rate of 1s. 6d. per share on the preference shares. This would absorb £623, leaving a balance of £57 to be carried forward to the next account. No further progress had been made in the negotiations with the Western and Brazilian Company referred to in previous reports.

Lieut.-Colonel G. W. Macauley seconded the adoption of the report, which was unanimously agreed to.

Sir Thomas Gore Browne, the retiring director, and Mr. W. S. Ogle, the auditor, were re-elected, and the meeting closed.

Daniel Judson and Son, Limited.

THE second ordinary general meeting of this company was held at the Guildhall Tavern on Monday, Mr. E. E. Harding presiding.

Having dealt with the general business of the company, in moving the adoption of the report (which recommended the payment of a 5 per cent. dividend), the Chairman further said: Another new branch started during the latter half of last year is an electrical business. Now, we are most anxious that the shareholders shall not fancy that we have been sinking their money in risky electrical speculations. Far from it; let me explain. Some months ago we heard that a small business, with works, &c., in our immediate neighbourhood was for sale, and on making most careful inquiries we were satisfied that, with the judicious use of a little of our capital, it might be developed into a very large business for manufacturing and supplying to the trade all kinds of useful domestic electrical apparatus, such as bells, medical batteries, mechanical telephones and numberless other articles required in the trade. I should have mentioned that the business included some very valuable patents for corrugated carbon cells and rods, and the necessary machinery and plant for making them. You will find full particulars of all these articles in the circulars in the room. We were able to secure this business on what we considered very reasonable terms, and I am pleased to inform you that we have very great cause to congratulate ourselves on the success of the investment, the net amounts of sales in this branch alone having increased from £13 6s. in June, £103 in July, and £134 in August, to nearly £500 per month for the last three months, and I am pleased to say the amount of orders coming in is daily increasing, and we have good reason to anticipate that ultimately our corrugated carbon cells will be adopted by all the large railway companies, &c., and in that case the demand would be simply enormous; the profits on this branch are large.

The report was adopted.

Globe Telegraph and Trust Company, Limited.—The directors have declared the payment of an interim dividend on and after the 19th inst. of 3s. per share on the preference shares, less income tax, and of 1s. 6d. per share on the ordinary shares, income tax having been already deducted, for the quarter ending April 18th.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 25th were £3,429 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending March 25th amounted to £4,307.

NEW PATENTS—1887.

4369. "Detecting and measuring electric currents." P. JOLIN. Dated March 23.

4375. "Insulating electrical conductors or wires." H. WEBER, R. SCHEFBAUER. Dated March 23. (*Complete.*)

4447. "Measuring, indicating and recording currents of electricity." P. B. ELWELL. Dated March 25.

4460. "Electro-dynamic and dynamo-electric machines." T. PARKER. Dated March 25.

4465. "Electrical reckoning machines." J. RETTIE. Dated March 25.

4472. "Electro-deposition of cobalt." S. P. THOMPSON. Dated March 25.

4478. "Supporting or carrying telegraph or telephone wires or lines." C. MAYNARD. Dated March 25.

4496. "Electric incandescence or glow lamps." A. BARKER. Dated March 25.

4515. "Incandescent electric lamps." W. MAXWELL. Dated March 26.

4527. "Electrodes for primary or secondary batteries, &c." L. EPSTEIN. Dated March 26.

4532. "Electric vehicle for running on ordinary roads." M. R. WARD. Dated March 26.

4533. "Electric vehicles." M. R. WARD. Dated March 26.

4545. "Electrical measuring and indicating apparatus." C. D. ABEL. (Communicated by Siemens and Halske.) Dated March 26.

4546. "Dynamo-electrical machines in combination with motor engines." C. D. ABEL. (Communicated by Siemens and Halske.) Dated March 26.

4549. "Electric incandescent lamps." A. FEATHERSTONHAUGH. Dated March 26.

4553. "Electric telegraph apparatus." W. DICKINSON. Dated March 26.

4571. "Making zincs for galvanic batteries." W. E. HEYS. (Communicated by J. Beattie.) Dated March 28.

4577. "Electric secondary or storage batteries." H. C. BELAUD. Dated March 28.

4635. "Telegraphic and telephonic call apparatus." C. L. BAKER, F. BRYAN. Dated March 29.

4636. Electric safety pistol for firing cannons and explosives." E. HOLLANDER. Dated March 29.

4648. "Primary batteries." C. L. TWEEDALE. March 29.

4664. "Electric furnaces for making aluminium." W. P. THOMPSON. (Communicated by E. H. and A. H. Cowles.) Dated March 29. (*Complete.*)

4667. "Galvanic battery solutions." W. P. KOOKOGEY. Dated March 29. (*Complete.*)

4696. "Electric indicating apparatus." H. H. LAKE. (Communicated by J. T. Murray.) Dated March 29. (*Complete.*)

4714. "Electrical signal bell apparatus for stations communicating with a single wire telegraphic circuit." F. A. AMORIC. Dated March 29.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

450. "Improvements in electric lamps." B. J. B. MILLS. (Communicated from abroad by André Million, of Lyons.) Dated January 11. 8d. Claims:—1. The method of obtaining a continuity of the light by means of a provision of rods or sticks of carbon succeeding each other automatically without stoppage in the production of the light, by the movement of a chain provided with catches and moved by the regulator, substantially as shown and described. 2. The regulation of the arc by a mechanism operated on the one hand for the approach of the carbons by an electro-motor with neither fly nor dead points, and on the other hand, for the separation of the carbons, by a counterpoised break, the retrograde motion of which is determined by the stoppage of the motor, substantially as shown and described.

1096. "Improvements in incandescing electric lamps and in the arrangement thereof." B. J. B. MILLS. (Communicated from abroad by L. Stieringer, of New York.) Dated January 25. 8d. Claims:—1. In an incandescing electric lamp, the glass stem through which the leading-in wires pass, filled with asbestos fibre or other suitable refractory insulating material, substantially as described. 2. Two or more incandescing electric lamps connected in series, each having the glass stem through which the leading-in wires pass filled with asbestos fibre or other suitable refractory insulating material in combination with electro-magnetic cut-out mechanism for each lamp, substantially as described.

1543. "Improvements in electric candles." G. IGNATIEV. Dated February 2. 8d. Claim:—An electric candle for use with constant currents and consisting of an inner carbon communicating with the negative pole of the dynamo or generator and surrounded by a tubular or outer carbon of the same density as the inner carbon and communicating with the positive pole of the said dynamo or generator the relative sectional areas of the said inner and outer carbons being adjusted in such a manner as to cause them to be equally or uniformly consumed, substantially as described with reference to the drawings.

2013. "An improvement in electric lamps." J. D. F. ANDREWS. Dated February 11. 4d. Consists in providing the additional resistance, usually employed in arc lamps, in the form of an incandescent or glow lamp or of several of these in the circuit of each arc lamp, so that their resistance is utilised in giving illumination in addition to that given by the arc lamp itself, and thus the loss due to resistance is lessened by turning that resistance to account. There is one claim.

2378. "Improvements in electric bells." S. A. VARLEY. Dated February 18. 8d. Claims:—1. The construction of an electric bell in which the axle carrying the armature and striking lever to which the hammer and balance weight are attached is mounted vertically and by which mode of construction the necessity for special apparatus to prevent false signals being given by the oscillation of the train is obviated and by which with a small motion of the armature through space the inventor obtains a large motion through space of the hammer, substantially as described and shown on the drawings. 2. The general combination and arrangement of parts together constituting the improved apparatus for giving signals in trains in motion, substantially as and for the purposes described and shown on the drawings.

2479. "Improvements in and relating to electric cables." W. T. GLOVER. Dated February 20. 6d. Claims:—(1) In an electric cable containing insulated telephonic or telegraphic conductors; the combination of a metallic core with one or more metallic sheathings the core and the sheathing or sheathings being connected to earth when the cable is in use; for the purpose of diminishing or neutralising the effects of induction, substantially as described. (2) An electric cable for telegraphic and telephonic purposes; consisting essentially of a metallic core, one or more series or surroundings of insulated conductors, a metallic layer sheathing or coating upon or around each series or surroundings of insulated conductors, and means for electrically connecting the core and the metallic sheathing or sheathings with each other and to earth; substantially as and for the purposes described.

2630. "Improvements in electrical indicators." B. J. B. MILLS. (Communicated from abroad by J. W. Howell, of America.) Dated February 23. 8d. This invention relates to an instrument for indicating changes in the electromotive force or for measuring the same, and is intended especially for use in systems of electric lighting to indicate variations of electromotive force, so that the generators may be regulated accordingly. Claims:—1. In an electrical indicator the combination of a resistance, sensitive to changes in temperature, as an incandescing electric lamp and a wire resistance in one side of a Wheatstone bridge and two wire resistances in the other side, all such resistances being proportioned substantially as described, and an indicator or recorder of current connected between the two sides, substantially as described. 2. In an electrical indicator wherein resistances are placed in opposite sides of a Wheatstone bridge and a current indicating device is connected between said sides so as to be affected by changes in such resistances, connecting a terminal of the indicating device adjustably with a resistance in one side of the bridge, substantially as described. 3. In an electrical indicator the combination of an incandescing electric lamp and a wire resistance in one side of a Wheatstone bridge, three wire resistances in the other side, and a current indicator or recorder connected between the two sides, one of whose terminals is connected with a contact adjustable upon the middle one of the three resistances, substantially as described.

2631. "Improvements in electric batteries." J. Y. JOHNSON. (Communicated from abroad by L. A. W. Desruelles, of Paris.) Dated February 23. 4d. Claim:—Protecting the soluble electrodes of electric batteries from corrosion by coating the said electrodes with a mixture compounded of fat or grease and mercury with or without the addition of another metal, substantially as described.

2760. "Novel means of applying electricity for therapeutic purposes." A. H. BYNG. Dated February 25. 8d. Consists in fitting or providing a room, chamber or apartment with electrical contrivances whereby it can at the will of the occupier be brought into an electrical state. There is one claim.

3598. "Improvements in electrical switches." H. W. EDLIN. Dated March 13. 8d. Consists in the combination with the plug of a toggle device which acts in such a manner as to positively maintain the plug in either of its extreme positions. This may be effected by making the plug serve as the centre joint of two or more toggle levers, the other ends of said levers being jointed or pivoted to springs which have a constant tendency to press inwards towards each other and forcibly throw the plug or centre joint out of line with the outer ends of the toggle levers; or the toggle levers may be made in two parts arranged to slide one over the other and provided with a spring which tends to elongate the levers; or a straight flat spring may be substituted for the jointed toggle levers, the said spring being confined within the box or casing in such a manner that it is normally curved out of the straight line, and passing through the stem of the plug. The claims are two in number.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, March 24th, Sir CHARLES BRIGHT, President, in the chair. The minutes of the last ordinary general meeting having been read and confirmed and the list of new and proposed new members announced, a paper by A. E. KENNELLY, Associate, on "The Resistance of Faults in Submarine Cables," was read by the Secretary.

Although there can be little doubt that the laws which are about to be stated control all faults in sea water, yet their practical application will be found to be limited to large, open exposures, such as occur in the majority of cases where cables are totally broken. On this account we shall confine our attention to "total breaks." Although there are many different methods in use for the measurement and elimination of the resistances of faults, or partial earth, in cables, there has been up to the present time apparently only one published method for measuring the resistance which the broken end of a cable offers, and that—due, we think, to Mr. H. R. Kempe—is based upon the measurement of the amount of discharge from the cable immediately after a balance has been obtained by Wheatstone's bridge. The difficulty which is so frequently met in executing this test is the elimination of the rapidly falling polarisation current from the first throw of the galvanometer needle, which should register discharge only. The formulæ for separating the effects upon a galvanometer needle, of a steady current from a discharge current combined, are published in the Journals of the Society; but when the polarisation current is a large fraction of the discharge, its rapid fall in intensity still further complicates the subject. The course, therefore, almost invariably adopted for localising a break by the tests from one end of the cable only is, as we all know, to reduce the break's resistance by suitable methods, such as Lumsden's, to an apparent practicable minimum, and then to estimate the value of this minimum from the general "behaviour" of the break, *i.e.*, its variability under varying testing currents. In practice, the most common minimum resistance of a break arrived at in this way may be placed between 10 ω and 40 ω; less frequently between 5 ω and 75 ω; while in rare cases the limits zero and infinity are approached. In the former case the conductor is in firm metallic communication with the sheathing of the cable, and in the latter the end of the conductor is so nearly enveloped by its gutta-percha covering that the hydrogen evolved in testing completes the seal.

It has long been known that the resistance of a fault diminishes when the current strength passing through it increases, so long as the exposed surface is maintained constant; but the rate of the diminution for a given current increase seems to have hitherto evaded inquiry. The results of a series of experiments extending over several months, made with a view to studying the rate of diminution in resistance for increasing current strengths, seem to show that all faults obey two simple, mutually supporting, conjugate laws, whose effects, however, in practice appear to be greatly masked and encroached upon by disturbing influences of a physical nature. The two laws may be stated thus:—

I. The resistances of a constant area vary inversely as the square roots of the current strengths.

II. The resistances to a constant current vary inversely as the square roots of the exposed areas.

So that, if these laws are true, we halve the resistance of an exposure either by quadrupling the strength of the traversing current, or, if the current remains unaltered, by quadrupling the exposed area. It is easily seen that the demonstration of one of these laws causes the truth of the other to follow as a corollary.

It becomes, therefore, only necessary to confine our experiments to the measurement of the resistances offered by varying exposures to the same current in order to arrive at the law of the resistances offered by a constant exposure to varying currents, and perhaps the former is the simpler experimental problem. But, whichever plan is followed, the great source of error and difficulty in making these experiments is found, as might be expected, in polarisation.

It interferes, as we all know, in three ways—1st, mechanically, because when either gas or a metallic salt accumulates on the exposure, the area exposed to free liquid contact is reduced to an extent that it is impossible or very difficult to ascertain; 2nd, electrically, because the gas generated opposes a varying electromotive force to the testing current, which is thus altered from the strength calculated for, and the exact correction is difficult to arrive at; 3rd, electrically, because this electromotive force of polarisation existing in the circuit whose resistance is to be measured causes a large error to be made in the measurement, and owing to the great rapidity with which it falls, the moment the testing current ceases, the exact correction to apply is difficult to obtain. Of these three errors the last is generally by far the greatest, and has probably been chiefly instrumental in enabling the laws of fault resistance to evade exact inquiry.

It may be premised that all the measurements in this paper have been taken with the Wheatstone's bridge, and the corrections for the third polarisation error mentioned above have been all effected by reading to the polarisation current as zero, or by what is commonly called "false-zero" reading.

Experiment.

From a sheet of tinned iron 0·5 mm. thick, eight plates were cut, each approximately 15 cms. × 2 cms., with a copper wire soldered to one end. They were then immersed in salt water, by means of a suitable frame, to about 7 cms. in depth, each plate thus exposing about 28 sq. cms. of surface to the water.

The resistances of various combinations of these exposures were then measured directly by Wheatstone's bridge, with a current maintained at 10 milliampères in the exposure arm. By means of a metronome striking a bell at one, two, or more seconds, the time intervals were appreciated between the cessation of the testing current and the observation of the polarisation "false zero."

The table shows the comparative resistances measured in this way, the zinc pole of the battery being to bridge.

TABLE I.

No. of Series.	Strength of Current through Total Exposure.	Interval of Time between Cessation of Testing Current and the Observation of the False Zero of Polarisation.	Number of Plates connected in Parallel Circuit, and the corresponding Resistance observed.								Mean Coefficient of Resistance reduction for a Doubled Area of Exposure.
			1	2	3	4	5	6	7	8	
	Milli-amperes	Seconds.	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	
1	10	...	12·5	9·1	7·5	6·3	5·8	5·3	4·9	4·6	0·714
2	,,	1	48	43	39·5	36	33	29	26	22	0·770
3	,,	2	55	52	48	44·5	39	34·5	31·5	28	0·789
4	,,	3	62	57·2	52·5	45·5	43	41	39	36·5	0·826
5	,,	4	64·5	59·5	53	49	46·5	44·5	42	39	0·845
6	,,	5	66	61·5	56	52	48	45·5	43	40·5	0·842

Here the apparent resistance of exposures with 1, 2, 3, . . . to 8 plates—corresponding to about 28, 56, 84, . . . to 224 square centimetres—is shown in respect to time. Series No. 1 is supposed to have been observed at an exceedingly small interval after the cessation of the battery current. It may be called the series at 0 seconds, or the series taken to "immediate false zero." The false zero so observed would therefore be the correct measure of the polarisation electromotive force during the last flow of the testing current, and consequently the observed resistances in this series No. 1 should be the actual resistances which that current encountered. It will be seen that the results obtained in this series follow the law of inverse square roots closely; that is to say, the resistance is approximately reduced one-half by quadrupling the exposed surface. The coefficient of resistance reduction for a doubled surface by inverse square roots is of course $\frac{1}{\sqrt{2}} = 0{\cdot}707$, and the mean coefficient in this observed series is

$$\frac{\frac{9{\cdot}1}{12{\cdot}5} + \frac{6{\cdot}3}{9{\cdot}1} + \frac{5{\cdot}3}{7{\cdot}5} + \frac{4{\cdot}6}{6{\cdot}3}}{4} = 0{\cdot}714.$$

The difference between the observed and calculated coefficients is 0·007, or about 1 per cent. This discrepancy may be accounted for either by error of observation, by the interval of time between the cessation of the testing current and the false-zero observation not approaching zero closely enough, or by any extraneous resistance in the exposure circuit between the face of the liquid envelope and earth. The last two sources of error would inevitably increase the observed coefficient.

The table shows the effect on the quantity of balancing resistance brought about by the selection as zero of any particular distance in time along the spot's path. Now, if, as was in this experiment observed, there is no appreciable electrostatic or electro-magnetic capacity in any of the arms of the bridge to disturb the galvanometer on opening or closing the battery circuit, the rush of the spot in the first direction must be due to the polarisation electromotive force existing in the exposure circuit during the last moments of testing current flow, and consequently the correct position of the spot to select as zero is that position which in its first throw it endeavours to reach. Accordingly, in observing series No. 1, the balancing resistance was reduced step by step until this first throw was so far diminished as to be no longer appreciable. So rapid is this first throw that perhaps the vanishing limit was not actually attained, and the resistances may therefore be slightly in excess of their true values. This may account for the slight discrepancy between the observed and calculated coefficients already mentioned.

When the exposed surface is of such dimensions that the gases developed are readily disengaged, and do not accumulate, we may expect the observed resistances to fall within the law. This is, fortunately, the case in the majority of exposures that broken cables offer.

It would appear in practice that for feeble currents—that is to say, testing currents below 25 milliamperes—the observed resistances do not seriously diverge from the law, except, perhaps, where the length of cable between the observer and the break is very short; and that, consequently, by observing the resistances

with definite current strengths the actual resistance of the break can be determined.

This is the more fortunate, since if the law were found to be followed by strong rather than by weak currents its efficacy would be limited to breaks comparatively close to the testing station. For, instance, with a battery power whose electromotive force is 50 volts and internal resistance 100 ohms, an observer using a Wheatstone's bridge with a ratio of 100 ω : 1,000 ω can force 25 milliampères through a break offering 50 ω when it is 1,740 ω distant from him; while with the same connections he could not force 200 milliampères through the break further than 30 ω from him, even if it only offered 10 ω resistance at the time.

The following table, among others, shows the results obtained with an actual break in a cable of the Eastern Telegraph Company, by whose permission they are placed before the society. In all these observations the law is submitted to a crucial examination, because the readings are here given just as they were obtained, and before the resistances of the various faults were at all accurately known. All the readings were taken by bridge to a false zero on a rather dead-beat galvanometer as soon after the cessation of the battery current and the discharge from the cable as possible—generally between one and two seconds' interval.

TABLE VI.—BROKEN CABLE NO. 4.

I. Testing current. Milliampères through break. Zinc to line.	II. Observed resistance of cable and break.	III. Estimated distance of break.	IV. Consequent resistance of break observed.	V. Calculated resistance of break from observation with 4 milliampères.
	Ohms.	Ohms.	Ohms.	Ohms.
1	1,888·2	1,778	110·2	90·2
2	1,833·2	...	55·2	63·8
3	1,828·2	...	50·2	52·1
4	1,823·1	...	45·1	...
5	1,818·1	...	40·1	40·3
6	1,813·1	...	35·1	36·9
7	1,811·1	...	33·1	34·1
8	1,809·1	...	31·1	31·9
9	1,807·1	...	29·1	30·0
10	1,805·1	...	27·1	28·5
11	1,804·1	...	26·1	27·2
12	1,803·1	...	25·1	26·0
13	1,802	...	24	25·0
14	1,801	...	23	24·1
15	1,801	...	23	23·3
16	1,800	...	22	22·6
17	1,799·5	...	21·5	21·9
18	1,799	...	21	21·3
19	1,799	...	21	20·7
20	1,798·5	...	20·5	20·2
21	1,798·5	...	20·5	19·7
22	1,798	...	20	19·2
23	1,797·5	...	19·5	18·8
24	1,797	...	19	18·5

The actual distance of this break was not determined, but the estimated distance, 1,778 ω, must have been very near the truth, the Lumsden minimum being 1,783 ω at 27 milliampères.

The table seems to show that when the resistance of a break is steady for a particular steady current traversing it, of less than 25 milliampères, the resistances it offers follow the law of inverse square roots of the current strengths with sufficient accuracy for the purposes of measurement.

When a series of resistances has been observed, the deduction of the break's resistance is a simple matter.

It is best to take an odd number of the readings in the neighbourhood of 4 milliampères, and the corresponding quadruples—say 3, 4 and 5, with 12, 16 and 20 milliampères.

For instance, in the last table the resistance observed at 3 milliampères was ... ... 1,828·2 ω
And the resistance observed at 12 milliampères was ... 1,803·1 ω
25·1 ω

Now, by the law, the difference between these must be half the resistance the break offered at 3 milliampères, and consequently the whole resistance it offers at 12 milliampères.

Subtracting again, therefore, the distance of the break ... ... = 1,778 ω

Again, the resistance at 4 milliampères was ...	1,823·1 ω	and at 5 milliampères		1,818·1 ω
Again, the resistance at 16 milliampères was ...	1,800 ω	„ 20	„	1,798·5 ω
∴ the resistance of the break at 16 milliampères was	23·1 ω	„ 20	„	19·6 ω
∴ the distance of the break ...	... = 1,776·9 ω	and		= 1,778·9 ω

The mean distance of the break, from these three ... = 1,177·9 ω

For the future, we may well entertain the hope that the law may equally be found to apply to results obtained by the deflection method of measurement. If so, scarcely any calculation would be needed; for so long as the currents sent from the battery do not exceed 25 milliampères the resistances of the break would be in proportion to the square roots, inversely, of the observed deflections from the true scale zero, while the artificially reproduced deflections would be adjusted to the polarisation or false zero only. It would therefore be merely necessary to adjust so as to obtain convenient deflections from true zero and their quadruples, then observing the false zero as soon as possible in each case, to reproduce by resistance the deflection from that false zero. The absolute current strengths through the break would not be of consequence.

It may also be possible to extend the range of current strengths that we can employ by experimentally arriving at an empiric series of currents above 25 milliampères for whose components, and for a particular interval of false zero reading, the rate of diminution in the break resistance will be determinable.

In the discussion which followed the reading of the paper,

The PRESIDENT stated that the variability of the fault was the great difficulty to be got over.

Sir HENRY MANCE said that the question of the resistance of faults had occupied his attention for many years; the method by which he avoided the effects of polarisation currents was, as he had before pointed out to the Society, that of obtaining two resistance readings with different resistances in the arms of the bridge. His method appeared to have been misunderstood, as he did not claim to eliminate the resistance of the fault but only the effect of the polarisation or the earth current. His method, however, would at the same time enable a fair idea of the resistance of the fault to be obtained. Combined with his method, Mr. Kenelly's method enabled all the information required to be arrived at. On examining the figures he had given in his own tables, he found that Mr. Kenelly's law was substantially borne out. One part of the paper appeared to be rather complicated; the more simple the test was made the better, as there were many who could not execute an elaborate test. He considered that the author had made the testing of faults an exact science, and that he deserved great credit.

Mr. HAROLD ANSELL referred to a test which he had been able to make in the space of ten minutes, the result giving the true distance of the break (33 miles) within 1 ohm. On another occasion he had succeeded in localising a break at a distance of 35 miles within 3 or 4 ohms, the test taking about half an hour. He thought that the author's test would be best effected if the first measurement were made with the stronger current. He, himself, had never found Sir Henry Mance's method to give satisfactory results as the polarisation current changes so rapidly. He considered Mr. Kenelly's method to be perfect.

Mr. GRANVILLE would ask whether the author's and Sir Henry Mance's methods could not be combined, since in the latter, the current strength became changed?

Mr. DONOVAN would have liked to have known whether Mr. Kenelly had had any exerienpce of faults in which the broken cable had its end embedded in mud. Such faults behaved differently to those in which the cable was in clear water on a rocky bottom.

Professor W. E. AYRTON said that he had listened with very great interest to Mr. Kenelly's paper. In the determination of the position of a fault there were three elements to be considered, viz., the resistance of the cable up to the fault, the resistance of the fault itself, and the polarisation or earth current. Sir Henry Mance's test eliminated the latter, and Mr. Kenelly's test the fault resistance, the latter being in fact given by a formula of the form

$$f = \frac{f_o}{\sqrt{a\,c}}$$

He was not aware before the paper was read that the resistance of the fault varied as the square root of the current, but certain results which he had himself obtained; certainly bore this law out, though others did not. He would like to know the exact method employed in making the test, as this was not clear from the paper.

Mr. RYMER JONES said that he remembered the time when Sir Henry Mance's formula was not thought much of, but he considered that this formula, in connection with Mr. Kenelly's tables, made testing complete. The author's rule appeared only to apply in the case of currents less than 25 milliampères; but the use of the results given in the tables where stronger currents than these were used, would still enable the required result to be arrived at. He thought that in testing very long cables there might be considerable difficulty in applying the author's method, as the earth currents were very powerful and would overpower the battery current unless the latter were very strong.

Sir DAVID SALOMONS would like to ask whether Mr. Kenelly's law could be proved theoretically.

Professor AYRTON said that the law was more akin to a chemical discovery, which was purely an experimental result.

Professor ADAMS having made a few remarks, the meeting adjourned.

Fire.—The workshops of Messrs. Muirhead & Co., electricians, Cowley Street, Westminster, were almost wholly destroyed by fire on Saturday night.

CORRESPONDENCE.

Faults in Submarine Cables.

Submarine cable faults being once more the subject for consideration at the last meeting of the Society of Telegraph Engineers, I have thought that a few notes from a cable-manufacturing point of view, on the means now employed to enable "factory faults" to be detected at the earliest possible stage of manufacture, might be of some interest.

In the early cables previous to 1860, the hemp or jute serving in which the core is imbedded was invariably saturated with tar as a preservative against decay by the sea water.

In 1860, however, Mr. Willoughby Smith first pointed out that the tar, as being an insulating fluid, had a tendency to "mask," or even seal up temporarily, any small faults or mechanical defects that might exist in the gutta-percha envelope. The insulating properties of tar being only of a low, unreliable and temporary nature, the above effectual concealment (beyond the search of an electrical test) would last till a time when such faults were subjected to any strain (as by submergence) or to the searching conducting properties of the sea, when they would suddenly break out at a somewhat inconvenient stage, as was, no doubt, hitherto frequently the case.

We are next indebted to Mr. Willoughby Smith for then introducing the application of tannin (the bitter element of bark) or of brine in place of tar, as being a *conducting* rather than an insulating fluid, and thus possessing the tendency to "show up" (or even develop) any such faults on the application of the jute round the core, instead of temporarily concealing them.

This method has since been universally adopted, the jute and hemp servings being very generally steeped in tannin (or "cutch" as it is often termed) previous to use in submarine cable construction.

In some cases the jute bedding in which the core is enclosed is applied *wet*, so that the object aimed at is more readily attained on the compression of the iron wires from the lay-plate during the process of sheathing having the effect of *squeezing* the water (or "cutch") into any little aperture or mechanical defect that may exist in the gutta percha envelope.

By this method, then, in conjunction with a continuous electrical test for insulation being kept on the core whilst it is being covered, a "factory fault" may often be detected on the instant of application of serving or sheathing wires over the defective part and a repair very readily carried out; in striking contrast to the great source of trouble (involving proportional expense) that such a fault might have led to afterwards if not developed till the course of, or still more after, submergence.

This should not be forgotten as one of the principal advances made just at that very critical period of submarine telegraphy, when so many of the improvements now in practice were first introduced.

In 1859, a joint patent was taken out by Messrs. Chatterton and Willoughby Smith for an adhesive composition, which is now universally employed in all submarine cables as being an excellent medium for cementing together the separate coatings of gutta-percha envelope (where it is laid on in more than one coating) besides the first coating with the copper conductor.

This compound is usually composed of the following proportions by weight, viz., gutta-percha, 3; resin, 1; and Stockholm tar, 1.

As was implied by the president, in opening the discussion at the last meeting of the Society of Telegraph Engineers, it is not improbable that small faults or deficient insulation in any one of the coats may, inadvertently, be temporarily "masked" by even *this* small proportion of tar in the above adhesive composition applied between each covering.

Whether or no this possibility is sufficient to warrant he necessity, or advisability even, of an insulation test being made on the application of *each* coat of gutta-percha (*previous* to the adhesive compound being applied ready for the next coat or perhaps afterwards as well) is a point of some interest and importance to be determined only by those responsible and more experienced than myself.

The only tar outside the *outer* coating of the completed core in a submarine cable of to-day is that in the Bright & Clark's bituminous compound as applied round the sheathing wires, but the tanned or wet jute immediately surrounding the core should have sufficient time to "bring out" any "factory fault" before the composition has travelled between the interstices of the wires.

I need hardly say that *factory* faults are the only faults over which we have any control in the way of early development at a convenient stage.

Charles Bright, Jun.

March 28th.

[Perhaps our correspondent is not aware that G. P. cores of cables are sometimes manufactured without any kind of compound between the layers?—EDS. ELEC. REV.]

Primary Batteries for Lighting.

There are at the present day so many inquiries for primary batteries for lighting purposes, and so little response to these inquiries in the way of actual description and verification, that a large primary battery that has been actually used with satisfaction and success for something more than a trial, and which has stood the grand test of experience, seems almost like the family ghost—something which everybody devoutly believes in, but which nobody has ever seen. In view of this, perhaps the following particulars may interest your readers. They refer to a large battery that was used for eight months by Messrs. Rowlands and Fraser, jewellers, of Regent Street, to light 10 5-C.P. lamps for their windows. The battery gave much satisfaction and was only disused when the electrician who put it up, Mr. E. G. Craven, of 22, Great George Street, Westminster, was commissioned to enlarge the installation into 40 10 C.P. lamps, with gas engine, dynamo, &c. There were 9 cells, rectangular, of glazed earthenware. Dimensions outside, 13 inches by 6 inches by 12 inches. Inside, about 1 inch less each way. Each cell contained a flat porous cell, $11\frac{3}{4}$ inches by $9\frac{1}{2}$ inches by $2\frac{1}{4}$ inches approximately, and about $\frac{1}{4}$ inch in thickness. In each cell was a carbon plate, 8 inches by 10 inches by $\frac{1}{4}$ inch, and two corresponding zincs. The battery gave about 8 ampères and 2 volts per cell, and was recharged three times a week, running six hours each night. The particular solution used, Mr. Craven reserves to himself, but it had no fumes; such, indeed, would have been fatal to its efficiency, with so much plate about the place. The cost of maintenance was about twelve shillings a week, and prime cost, about sixteen shillings a cell. It could be used with any of the double fluid solutions, especially the following, which I have found good: *Outer*, sulphuric and water 1 to 10. *Inner*, equal parts of saturated solution bichromate of soda and hydrochloric acid. This bichromate of soda I have found preferable to the bichromate of potash.

Edward Conry.

March 29th, 1887.

P.S.—It would be very useful and interesting if your readers would publish particulars of any similar batteries that have been used for a permanency. I believe there are many such.

The Statter Arc Lamp.—At the recent Building Trades' Exhibition, Messrs. Statter & Co., of West Drayton, showed samples of their arc lamp and of the Joel engine-dynamo. The Statter arc lamp has been selected by the contractors for the lighting of the Yorkshire Jubilee Exhibition at Saltaire, where about 120 lamps of 2,000 candle-power each will be employed.